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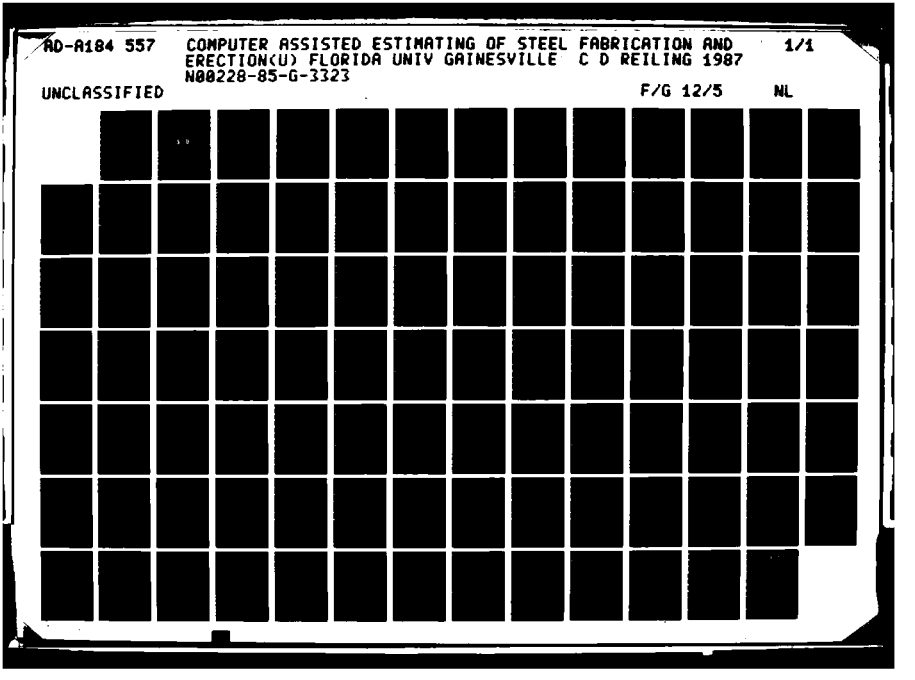

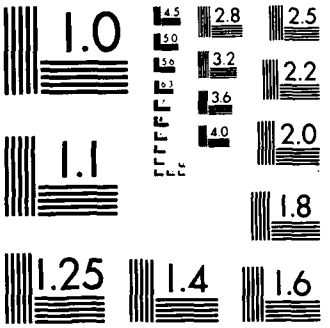

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COMPUTER ASSISTED ESTIMATING OF STEEL FABRICATION AND ERECTION

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BY

CHRISTOPHER D. REILING

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A REPORT PRESENTED TO THE GRADUATE COMMITTEE
OF THE DEPARTMENT OF CIVIL ENGINEERING IN
PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR THE DEGREE OF MASTER OF ENGINEERING

UNIVERSITY OF FLORIDA

SUMMER 1987

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CHRISTOPHER D. REILING

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TABLE OF CONTENTS

Chapter One - Introduction. 5

1.1 Purpose 5
1.2 The Importance of Estimating . . 6
1.3 Computer Assisted Estimating . . 7
1.4 Statement of Problem 10

Chapter Two - The Steel Fabrication Industry . 13

2.1 Purpose 13
2.2 Miscellaneous Metals and Structural Steel 13
2.3 The Steel Fabricator 14
2.4 Role of the Estimating Consultant . 16
2.5 The Role of the Computer Assisted Estimate 17

Chapter Three - Estimating Steel Fabrication and Erection 18

3.1 Purpose 18
3.2 Components of the Estimate. . . . 18

3.2.1 Labor 19
3.2.2 Material 21
3.2.3 Margin 22

Chapter Four - Development of the Computer Assisted Estimate . . . 25

4.1 Purpose 25
4.2 Establishing Program Requirements . 25
4.3 Selection of Software 27
4.4 Developing the Computer Assisted Estimate 29

Chapter Five - Program Operating Instructions . 35

5.1 Purpose 35
5.2 An Introduction to Lotus 1-2-3 Spreadsheet 35
5.3 Spreadsheet Organization . . . 36
5.4 Commands 38
5.5 Cautions 43
5.6 Performing a Computer Assisted Estimate 44

Chapter Six - Case Study 47

6.1 Purpose 47
6.2 The Computer Assisted Estimate . . 47

6.2.1 The Complete Estimate . . 47
6.2.2 The Work Sheet Estimate . . 50
6.2.3 Application of the Spreadsheet Estimate 50

Chapter Seven - Conclusion 52

Appendix A - Sample Complete Estimate . . 54

Appendix B - Sample Worksheet Estimate . . 69

Appendix C - Welcome and Data Input Screens . 84

Appendix D - Macro Library. 86

Bibliography 92

ABSTRACT

The steel fabrication industry in the Pittsburgh market area, generally defined as Southwestern Pennsylvania, Northern West Virginia, and the bordering sections of Ohio, is composed in part of specialty contractors who fabricate and erect miscellaneous metals and light structural steel for the construction industry. Many of these fabricators are small businesses which operate in a highly competitive environment. This environment and the custom nature of the steel fabrication industry make it both challenging and critical to have valid, reliable cost estimates.

This report will identify the need for and trace the development of a computer program designed to assist in estimating labor, material, and margin for the fabrication and erection of miscellaneous metals and light structural steel. The program uses a Lotus 1-2-3 electronic spreadsheet and the Lotus 1-2-3 macro command language. The computer assisted estimate models the estimating method which a consultant currently uses to provide an estimating service to the miscellaneous metals and structural steel industry.

CHAPTER ONE

INTRODUCTION

1.1 Purpose

This chapter will discuss the importance of accurate estimating to the construction industry, how computers can assist estimators, and the role a computer program could play in the miscellaneous metals and light structural steel industry. This report focuses on the Pittsburgh market area which is generally defined as Southwestern Pennsylvania, Northern West Virginia, and the bordering sections of Ohio. The development of the estimating program evolved through interviews with a consultant to the steel fabrication industry whose services include material takeoff and estimating. The program models the consultant's estimating method.

Later chapters build on the concepts introduced in this chapter. Chapter Two discusses the steel fabrication industry, the consultant's role within the industry, and establishes the need for a computer program to assist estimators. Chapter Three discusses the estimate components and how they combine to form a complete estimate. Chapter Four traces the development of a computer program which assists in estimating. Chapter Five is an operating manual for the program. Chapter Six discusses a case study to demonstrate the program's capabilities and the value of the estimate format. Chapter Seven presents conclusions and

recommendations based on the discussion in the previous chapters.

1.2 The Importance of Estimating

Estimating is perhaps the most important skill in the construction industry. The contractor is expected to make a significant financial commitment which is based on a forecast of future events. The estimate must account for all elements of cost and include sufficient profit to compensate for the risk assumed by the contractor. A high estimate may price the contractor above his competition. An estimate which is too low might result in a loss of profit and may cause the contractor to perform substandard work in an attempt to minimize loss or establish profit. Profit margin may also be adjusted to remain competitive, obtain market share, or maintain minimum workload. Accurate cost estimates are the foundation of good cost control. They permit the contractor to perform the work with adequate profit and quality, leading to satisfied customers and enhanced reputation.

There are numerous components to an estimate. Some components can be predicted with a high degree of confidence while others require making assumptions that involve more risk. Every construction project is unique because it was designed for its own environment, has a specific purpose or function, and can be constructed with a near infinite combination of materials, techniques, and site conditions. Construction estimating must, therefore,

be an integration of hard data, analysis, and judgement. Estimating is as much an art as it is a science. (1: 2-3)

Successful estimating requires a consistent, systematic approach. Key elements of any estimating system are consistent definitions of cost components, such as direct cost, overhead, and profit. Estimators should be able to call out their assumptions right on the estimate form to prevent any confusion. A consistent estimating system permits a basis of comparison between estimates and reduces confusion of estimate users. One method of achieving this consistency is to use a standard format for estimating. This format serves to channelize the estimator's thought process along the desired logic path. This reduces the possibility of procedural errors and costly omission errors that cut directly into profit. Critical to the success of an estimating format is the flexibility to permit the estimator to apply his experience and initiative. A good estimating format is highly structured to ensure accuracy, completeness, consistency and understanding, yet maintains enough flexibility for the estimator to apply judgement and document assumptions.

1.3 Computer Assisted Estimates

There are misconceptions regarding the role of the computer in estimating. Computers can perform the many mathematical calculations that are part of estimating with efficiency and accuracy. They can produce professional reports, and store and recall vast amounts of data.

Computers cannot apply experience and judgement to raw data to produce accurate estimates. The computer is a powerful tool which the estimator can use to access a greater volume of accurate and consistent information. The computer can then process this information thereby freeing the estimator to concentrate on the critical discretionary aspects of estimating. Computerized estimating can be used as a foundation for an integrated project management system involving estimating, scheduling, cash flow, cost control, and resource management. This section will trace the development of the computer as a tool to assist estimators.

Computer technology has changed dramatically in the 1980s. Microcomputers perform functions that only large and expensive mainframe computers performed a decade ago. New technology has effectively placed the power of a mainframe on a chip the size of a fingernail. As computer hardware costs fell within reach of small businesses, software developers began to develop applications for this new market.

Many "off the shelf" estimating programs were developed for the construction industry. These programs were not widely accepted for a variety of reasons. Change always meets some resistance. These estimating programs were not only introducing new technology, but requiring estimators to adapt their methods to the program's format. Many programs had rigid formats that automatically made key assumptions to facilitate routine data processing. This

created problems if the estimator and the estimate user were not familiar with the program's assumptions. Many estimators felt they no longer could apply their experience and judgement and were thus reduced to key punchers or take-off men.

Larger contractors hired computer consultants to develop programs that fit their specific estimating requirements. This was expensive, required valuable resources, took a long time to bring on line, and there was no guarantee that it would work or be accepted by the end users. Outside computer consultants, frequently with little or no knowledge of estimating construction costs, had to be hired to develop the program. Program support and expansion were costly and at times difficult to obtain. (6: Class Notes)

Recent developments in computer software have opened up new opportunities. Commercial software developers have produced powerful spreadsheet and database programs that include easy to learn internal programming languages. These internal programming languages frequently contain higher language functions that greatly expand the commercial software's capability and allow the user to customize the software by creating programs for specific applications. This ability to program within a program has enabled many contractors to develop their own customized estimating programs.

Lotus 1-2-3 is an electronic spreadsheet which has a macro command language. A macro command can be a series of

rapidly executed Lotus 1-2-3 menu commands or a combination of menu commands and special macro functions that permit user interface, logic decisions, "for" loops, and other capabilities normally found in higher programing languages. In addition to the mathematical applications normally associated with the spreadsheet, Lotus 1-2-3 has the ability to perform limited word processing, graphics and data base functions. Lotus 1-2-3 is discussed in more detail in Chapter Four.

Computer assisted estimating is gaining wide acceptance in the construction industry. Hardware and software technology have advanced to the point where microcomputers can provide powerful, easy to use applications. Graduates entering the work force are bringing with them a knowledge of computers. Current statistics indicate that 84% of the construction industry use computers with 45% of those using computers for cost estimating. It is clear that contractors must embrace computer technology in order to remain competitive in the years to come. (7: 36)

1.4 Statement of Problem

Estimating the fabrication and erection of miscellaneous metals and light structural steel (Miscellaneous metals and light structural steel will be called steel for the remainder of this report.) requires an extensive knowledge of the physical characteristics of many material shapes, fabrication and installation details,

methods, procedures, and other commonly required estimating skills. A computer program to assist in estimating steel would be directed toward freeing the estimator of the "busy work" of performing routine calculations and researching common physical characteristics, historical cost data, and productivity data.

This program is designed for a consultant who provides an estimating service to steel fabricators. The consultant's estimating method is the result of years of experience and is well received by his clients. A program to assist the consultant must be a near mirror image of the consultant's estimating method to retain the attributes of the original method and promote acceptance and continued satisfaction among his clients. The program must produce estimates in three formats:

a. Complete Estimate. The complete estimate is a written report concluding with a final selling price. Included are material costs, labor hours and costs, hauling costs, overhead costs, taxes, profit and scheduling data which apply to the project.

b. Work Sheet Estimate. The work sheet estimate is a printed report that provides material quantity take-off, labor hours, and generates blank lines for the client to enter his own labor costs, material costs, hauling costs, overhead costs, taxes, and profit. The client uses the worksheet estimate by systematically filling in the blanks with his own costs and the resulting calculations to

complete the estimate.

c. Spreadsheet Estimate. The spreadsheet estimate is a work sheet estimate provided to the client on magnetic media. The client uses his own computer to input his labor rates, material costs, hauling rates, overhead costs, taxes, and profit to complete the estimate. The client can also modify the quantity take off and labor hours as he sees fit. The client generates his own written report of the estimate.

The program must be able to recall the physical characteristics, historical cost data, production data, and other pertinent information of a large number of steel shapes and other material items. Routine calculations must be done by the computer. The program should allow the estimator to insert narrative for clarification or documentation of assumptions.

A typical estimate will include a base bid and several alternates. The program should provide complete estimates for the base bid and each alternate. (Base bid and alternate will be called alternate for the remainder of this report.) The program should also produce a summary of material required for each alternate. Many estimates involve jobs that extend over long periods of time. The program should be able to account for periodic wage changes that may occur over the life of the project.

CHAPTER TWO

THE STEEL FABRICATION INDUSTRY

2.1 Purpose

This chapter will define the steel fabrication industry to establish the role of the estimating consultant and the need for computer assisted estimating.

2.2 Miscellaneous Metals and Structural Steel

Steel fabricators are normally subcontractors who provide steel fabrication and erection services to the construction industry. Thus far, structural steel and miscellaneous metals have been combined and called steel, but there is an important distinction between the two.

Structural steel consists of hot-rolled steel sections, shapes, and plates not less than 1/8 inch thick, including all connecting devices necessary to hold a structural frame together. Miscellaneous metals are steel, aluminum, bronze, and other metal works that are architecturally necessary but are not required to complete the structural frame. Miscellaneous metals include such items as metal stairs, railings, ladders, fire escapes, floor gratings, curb angles, corner guards, and ornamental metal. Fabrication is the cutting, drilling, punching, welding, and surface treatment required to make the product ready for erection. Fabrication is normally done in

fabricating shops by steel workers. Erection is done in the field by iron workers. (12: 116)

Steel fabrication shops require a high investment in plant facilities and shop equipment. Fabricators tend to specialize in either heavy structural steel or miscellaneous metals due to the significant differences in equipment, plant layout, and labor skills required. Overlap between the two types of fabricators occurs in the area of light structural steel. This category of fabrication has been filled primarily by miscellaneous metal fabricators expanding the scope of their business.

The heavy structural steel fabricators bid large jobs and have their own in-house estimating systems with dedicated estimators. These companies have little need for the services of an estimating consultant. The medium to small fabricator, who specializes in miscellaneous metals and/or light structural steel, frequently has one man filling several organizational positions including estimator. It is to this type of firm that the estimating consultant can provide a valuable service.

2.3 The Steel Fabricator

The miscellaneous metals light structural steel (steel) fabrication industry is highly competitive and fragmented with many small fabricators competing for their market share. It is characterized by easy entry and has a high rate of business failure. Firms are typically constrained by some combination of the following: market

distance because of shipping costs, labor cost differences between areas, labor jurisdictions, organizational complications, financial capacity, and business knowledge.

The skills required within the firm can be divided into the three general categories of engineering, business, and artisan. There is frequently considerable overlap between these areas. Engineering skills involve engineering and architectural design; preparation of shop drawings to meet specifications and maximize opportunity for profit; estimating; and job site visits for field measurements, ensuring design constructibility, and scheduling work with customers. Business skills include accounting, budgeting, cash flow, planning for growth, profit analysis, credit and collections to name just a few. The artisan skills are complex and varied.

The sophistication of engineering and business skills found within steel fabrication firms varies greatly. The typical steel fabrication firm is spread very thin in engineering and business management skills. Frequently one person may perform several engineering and business functions, perhaps even work in the shop.

Shop skills are critical to the success of the firm. Skilled layout men, fitters, and experienced helpers are retained on a full time basis, rather than hired from job to job as practiced in other areas of construction. Firms must maintain a minimum workload to pay shop salaries and overhead.

Steel fabricators in the Pittsburgh market area have

been in a process of transition from union to non-union shops. When union shops dominated the industry, most firms had similar labor costs. With open shops, labor costs vary significantly from firm to firm. This is a major concern and underscores the pressure on firms to know and control their costs.

Fabricating steel involves work that is custom made for the requirements of a particular project. This work is non-repetitive and requires skilled management, shop workers, and erectors. Because of the competitive and custom nature of this industry, it is particularly challenging and critical for a firm to have valid, reliable estimates as well as to maintain low direct costs and overhead.

2.4 The Role of the Estimating Consultant

Estimating is a time consuming process that requires great attention to detail. Depending on market conditions, firms may have to bid a large number of jobs to reach their goals for shop workload, meet overhead commitments, and make sufficient profit. The estimating consultant estimates a project which he sells to several clients, thus spreading the cost of one estimate among several clients. This reduces the cost of the estimate to the client and frees his key personnel to perform other tasks.

The estimating consultant can not provide a complete estimate to bidding clients for legal reasons and because of differing labor rates, material costs, and margins among

clients. These rates are closely held secrets in such a competitive industry. The estimating consultant's service is normally limited to a work sheet estimate which includes material take off, estimates of labor hours, some design, opinion, and value engineering. The client uses the work sheet estimate to enter his own labor costs, material costs, and margin to complete the estimate.

2.5 The Role of the Computer Assisted Estimate

The computer assisted estimate will rapidly recall data, perform routine calculations and generally free the estimator of routine calculations and research. The written report is more consistent, more legible, provides more complete summary information, and provides a material summary. All of this by itself is of significant value to the estimator. However, the most significant improvement which the computer assisted estimate offers is the value of the spreadsheet estimate format to the client.

The consultant produces the spreadsheet estimate format exactly as the worksheet estimate format. The client receives the estimate on magnetic media and can easily input his own data and, if desired, modify the consultant's estimate to produce the completed estimate. This increases the value of the estimate to the client.

CHAPTER THREE

ESTIMATING STEEL FABRICATION AND ERECTION

3.1 Purpose

This chapter discusses the estimating system as modeled by the computer assisted estimate. The various components of the estimate are identified and explained.

There are several terms used in estimating construction costs that are important to this discussion. Direct costs are those which can be immediately associated with work directly contributing to the completion of the project. Indirect or overhead costs are those which necessarily contribute to the support of the project as a whole, but can not be identified directly with specific work items. Although these are commonly accepted meanings of direct and indirect costs, their interpretations vary widely. (4: 260)

Normally, the consultant's estimates are used by more than one client. Each client may interpret direct costs, overhead, profit, etc., a different way. The estimating method, therefore, must be general enough to accommodate different clients, yet specific enough to provide them with hard data.

3.2 Components of the Estimate

Each estimate has four distinct parts or sheets: the detailed estimate sheets, the summary sheets, the material

breakdown sheets, and take-off sheets. The detailed estimate sheets break the work into items. An item is a group of related material items, narratives, and any other appropriate entries. Key values of every item are calculated on the detailed estimate sheets as an aide in completing the estimate. (ie., Surface area of steel material is calculated to assist in estimating labor and material for painting.)

The summary sheets list item titles, key information concerning each item, margin, hauling, taxes, and total bid price. The material breakdown sheets list all individual material items and the calculated total weight required. This is useful in calculating material costs based on quantity discounts. Because most projects request base bids and a number of alternates, there is a separate summary sheet and material breakdown sheet for each alternate. Take-off sheets provide sketches and descriptive information that is not found on the other estimate sheets. They are performed by hand and are not discussed further in this report.

The three primary cost components of the estimating system are labor, material, and margin. This section will discuss these components and show how they are incorporated into the estimate.

3.2.1 Labor

Shop, erection, drafting, hauling, and management comprise labor. Labor cost is shown in both

hours and dollars. Labor hours are used to determine work load plans for that specific labor category. The dollar cost is the number of hours multiplied by the appropriate rate in dollars per hour. Labor costs vary with time as labor contracts frequently call for periodic wage and benefit increases. The change in labor cost over time is particularly important on large jobs which may extend for months or years.

Timing is accounted for in the estimate by identifying what period of time work on an item will be done. The increment of time used is normally three months but it can be adjusted as conditions dictate. Labor rates can be varied based on the quarter that the work will actually occur. A glance at the summary sheet shows how much work is scheduled for each labor category for a particular quarter.

Shop labor is required to fabricate a material item. One method of calculating it is by multiplying the weight of the material by a productivity factor. The productivity factor is based on experience and accounts for the various shop functions that must be performed. Surface treatment of the material is inserted as a separate line item with the shop labor determined by multiplying the square feet of surface area by a productivity factor.

Erection labor hours are determined based primarily on experience. There are many factors which affect steel erection including skill of erectors, site conditions,

coordination with other contractors, labor environment, type of connections, weight of steel, weather, height of work, and support equipment available to name just a few. Because of the many factors that are involved, erection hours are best determined by looking at a system of members rather than at only individual members. Erection hours, therefore, are determined for each item as a whole.

Drafting hours account for the production of shop drawings. Management hours include field measurements, other technical support, and direct management required to translate the customer's requirements into a finished product. The estimated hours for drafting and management are for the time spent that is directly attributable to that particular job and are thus direct costs. Drafting and management hours, like erection, are estimated for each item as a whole. Hauling labor is estimated as a line item on the summary sheet for the entire alternate.

3.2.2 Material

Normally, steel is priced by weight. Multiplying the quantity of the item, the length of the item, and the unit weight of the item determines the weight of the material required. This is then multiplied by a unit cost in dollars per pound. The cost of steel varies with the quantity purchased. The material breakdown sheets are used to determine the quantities of material that might be bought at once. This is helpful in determining volume discounts and in establishing accurate unit prices.

One time costs and special equipment that is rented or purchased for a particular job is treated as a material cost. Most work is accomplished using common tools and equipment which are charged to overhead.

3.2.3 Margin

Margin can be defined as the difference between the fabricator's direct costs and the final bid price. The margin must account for the manufacturing and administrative overhead costs of the firm and allow for adequate profit. Overhead and profit must be systematically applied to the direct costs to accurately charge for the product.

The wide range of sophistication among fabricators complicates the use of one estimating system by more than one fabricator. It is presumed that each client has his own method of recovering overhead costs and making adequate profit. To be of value, the consultant's estimating system must be able to accommodate the various methods which the clients use.

One method of accounting for overhead expenses for estimating purposes is to:

a. Identify and total each overhead expense over a period of time, such as two or three years.

b. List the direct cost values of labor and material accounts or categories over this same period of time.

c. Analyze each overhead cost by dividing it among the direct costs that cause the overhead cost. (ie., A

portion of the overhead expense for owning, operating, and maintaining the fabrication shop would be charged to material to recover storage expenses.)

d. Determine the percent overhead to be applied to each direct cost category by dividing the sum of the overhead cost categories assigned to each direct cost by the total value of the direct cost over that same period of time.

This method is an attempt to forecast future overhead expenses and recover them by charging them as a percent to direct costs. As in all estimates, judgment should be applied at all stages of this procedure.

Profit is normally given as a percent of direct cost plus overhead. Market conditions may cause profit margins to fluctuate. Some of the key considerations in determining a profit margin are: what the market will bear; market share; overhead commitments; maintaining a steady shop load; and what return can be realized through other investments. Frequently fabricators will establish set profit margins and adjust their bid by adding a contingency cost to account for anticipated problems or deducting an amount to reflect anticipated economic "breaks".

The estimating system is designed to account for overhead and profit in the manner described above. It also can easily be used by a client to account for overhead in any number of ways. For example, a client may charge all

of his overhead expenses to shop and erection labor only. The estimating system easily accommodates most methods of applying overhead to direct costs.

CHAPTER FOUR

DEVELOPMENT OF THE COMPUTER ASSISTED ESTIMATE

4.1 Purpose

This chapter traces the development of the computer assisted estimate. It defines program requirements, discusses software selection, and concludes with a discussion of problems encountered in program design and their solutions.

4.2 Establishing Program Requirements

The program objectives were established by agreement between the consultant and the program author. The primary objectives are listed below with explanations when appropriate.

1. Produce a report printout similar in format to the hand written estimate. The estimate format is the end product of years of development and was not to be degraded by program limitations. This was also desirable to promote acceptance from clients. The similar format would not require them to adapt to a new system.

2. The program should generate estimate reports in three distinct formats:

a. Complete Format. The complete estimate format requires no additional data input and concludes with a total bid price.

b. Work Sheet Format. The work sheet format is a

printed report that provides material quantity take-off, labor hours, and blank lines for the client to input his own labor rates, material costs, profit, taxes, hauling expenses, and overhead. The client fills in the blanks to complete the estimate.

c. Spreadsheet Format. The spreadsheet format provides the client with the work sheet estimate on magnetic media. The client can then use his own computer to input his labor rates, material costs, profit, taxes, hauling expenses, and overhead to complete the estimate.

3. The program should be able to recall historical cost data, productivity rates, and physical characteristics of material items.

4. The program should be able to break the estimate into sub-sections called items and provide item totals.

5. The program must provide the user the opportunity to document assumptions and otherwise insert narratives in the estimate.

6. The program should provide a summary sheet for each alternate, listing the items that compose the alternate, key item totals, and overhead and profit for that alternate.

7. The program should account for overhead, taxes, hauling and profit. The program must be flexible enough to accommodate a variety of overhead accounting procedures.

8. The program should provide a material breakdown for the base bid and each alternate which lists the total quantity by weight of the specific material items required

for each alternate.

9. The summary sheet and the material breakdown sheet must be integrated with the detailed estimate so that a change on the detailed estimate would be reflected in the other sheets.

10. The program should be functional and user-friendly enough to enable clients to quickly benefit from the spreadsheet format.

11. The program should account for differing wage rates as work extends from one wage scale period to another.

12. The program should produce separate summary sheets and material breakdown sheets for each alternate.

4.3 Selection of Software

To meet the objectives outlined in the previous section, it was determined that both spreadsheet and database software packages were available that could be customized to meet the requirements. Table 1, shown on the next page, is a comparison of database and spreadsheet features.

Both options offer some distinct advantages. The database program researched was dBase III Plus. dBase III Plus is user friendly and has an advanced internal command language that enables programers to create sophisticated applications. Dbase III Plus' strongest point, in comparison to Lotus 1-2-3, is the sophistication and flexibility of its internal command language. In this

specific case, however, this sophistication had a negative impact. The complexity of the command language would have required the programer and estimator to spend a great deal of time learning it. This was not practical. dBase III Plus would not be as well received by clients because it is more difficult to use and not as well known as Lotus 1-2-3 within the industry.

TABLE 1

DATABASE vs. SPREADSHEET

	Database	Spreadsheet
Custom Written	Involved	Not so Involved
Size	Unlimited	Limited by RAM or software
Speed	Slower	Faster
Accuracy	Good	Good but with potential problems with equations
User Friendly	Very	Not so Friendly
Sophistication	Unlimited	Limited
Ability to be Modified by User	Limited	Some but can be dangerous and involved (6: Class Notes)

The spreadsheet software researched and finally selected for use was Lotus 1-2-3. Lotus 1-2-3's macro command language is easy to learn and apply. The electronic spreadsheet is common today and clients who are not already familiar with Lotus 1-2-3 can quickly learn it for this estimating application, as well as others.

Lotus 1-2-3 Release 2.01 is a spreadsheet program with 256 columns, named "A" through "IV", and 8,192 numbered rows. The power of Lotus 1-2-3 stems from its hierarchical menu structure which can perform many functions through a series of key strokes. Macros are a programmed series of key strokes that take advantage of the hierarchical menu structure. Macros also contain many functions that go beyond simple menu command key strokes. These special functions make the macro command language a powerful tool to harness capabilities of the Lotus 1-2-3 worksheet.

4.4 Developing the Computer Assisted Estimate

The computer assisted estimate has undergone two complete revisions. Each revision was based on user feedback and increased knowledge of Lotus 1-2-3's capabilities. This led to refined program requirements. The problems encountered when developing the computer assisted estimate played major roles in shaping the program's final form. Some of these problems are discussed below along with their solution and the impact the problem had on the final program.

Random Access Memory (RAM), the computer's internal memory, is used to store the instructions of the program being run. The computer assisted estimate requires that Lotus 1-2-3 and the program template be loaded in RAM to perform the estimate. RAM became a key consideration when the size of the macro program, data base and other estimate components of the program template used enough RAM memory

to place an unreasonable restriction on the size of the estimate being performed. This problem was a major consideration in the re-organization of the spreadsheet during the first revision. Despite the improved organization of the spreadsheet, RAM still placed an unreasonable restriction on the size of estimates that could be generated.

The largest drain on available memory is the data base which has over 800 records. The data base is essential for performing the detailed estimate but is not used in the construction of the summary sheets and material breakdown sheets. These sheets are generated by macro based on informat n contained in the detailed estimate. The memory problem was alleviated by erasing the data base before constructing the summary sheets and the material breakdown sheets. Even with this solution, the size of the estimate is still limited by RAM. The program requires 640 kilobytes of RAM to load and perform medium size estimates. The best solution is to increase RAM through a hardware upgrade.

Lotus 1-2-3 has a very limited ability to transfer data between files using the "/FC" menu command sequence. This command has a major flaw in that it does not transfer range names with the data. Data transfer is not used because the computer assisted estimate makes extensive use of range names as part of macro command execution. This compels each estimate file to be begin as a template complete with data base, input data screen, and macro

library. This is a disadvantage compared to other programming languages which allow the program storage to be separate from data storage and recall.

The macro command language is limited in the number of macro levels or subroutines that can be used on any one macro command. The macro command to generate a summary sheet and material breakdown sheet for each bid alternate involves numerous logic functions which instruct the computer on where to go to look for further instruction if certain conditions are met. This would normally involve a sub-routine, but the limitation on macro levels prevented this. The solution was to use the "/XG" macro which tells the computer what cell location the next macro command is contained in. This tricked the computer into believing that the macro was one long macro without any sub-routines. There are two draw backs to this approach. The first is some advanced macro functions that rely on sub-routines could not be used. Macro routines had to be incorporated into the program to replace these functions. The second problem is that it makes understanding, documenting, and debugging macros very difficult.

The speed of macro execution was affected by the size of the estimate. As the estimate became larger there were more calculations to be performed and the computer's execution time noticeably increased. This problem was partially alleviated by setting Lotus 1-2-3 to manual recalculation and including the calculate command in each

macro. Most of the macros used while estimating are involved and take relatively long to execute. The best solution to this problem is to purchase a computer with a high clock speed. A math co-processor would decrease calculation time but have little affect on the speed of macro execution, the primary time consumer during macro execution.

One problem with programing complex macros is keeping track of what cell the cursor is in during macro execution. With this information, that cell and surrounding cells can be edited, copied to other areas of the work sheet, or used to receive information. This problem is compounded when creating the variable length summary sheets and the material breakdown sheets. The macro that performs this functions takes information from the detailed estimate sheet and the data input screens to construct the material breakdown sheet and the summary sheet.

This involves performing functions in three different work areas within the spreadsheet. The three work areas, the detailed estimate, the summary sheet, and the material breakdown sheet all are variable length. Information in different locations within each work area must be sent to various locations in other work areas. The problem is to define the changing locations within each work area so that information exchange can take place. Two known locations are required to communicate.

To accomplish this, the macro uses a "floating" range

to define a location within each work area. Information is then processed between the work areas at the location of the ranges. After the information is processed, the ranges are moved to new locations for further information processing. Each material breakdown and summary sheet is constructed this way.

An example of a "floating" range application is the transfer of information from the detailed estimated to the summary sheet. The floating ranges in the detailed estimate and summary sheet work areas are called DE and SS, respectively. DE is located at the cell containing the total item material cost. SS is located at the cell on the summary sheet that is to contain the total material cost. The information is sent from DE to SS. The next information required to construct the summary sheet is the total item price. SS moves over one column and resets its location. DE moves down two rows, left eight columns, and resets its location. Information can now be exchanged. This system works on known relative distances between cells.

Lotus 1-2-3 has a protect feature intended to keep data from being destroyed. This could be particularly beneficial in protecting the data base and the macro commands from accidental destruction. The first version used the protect feature but it soon became more trouble than it was worth. Information retrieved from the data base had to be un-protected, all work areas had to be un-

protected, and the protect feature used up large quantities of memory. The solution was simply to rely on caution on the part of the estimator when using the program. Implementation of this solution precludes the use of the insert, delete, and page commands which could destroy portions of macros and the data base that otherwise would be protected.

CHAPTER FIVE

PROGRAM OPERATING INSTRUCTIONS

5.1 Introduction

This chapter will explain the operating characteristics and mechanics of the estimating program. Lotus 1-2-3 and its internal macro command language are discussed. With this foundation, the spreadsheet organization will be explained followed by a list of macro commands. A basic knowledge of Lotus 1-2-3 is necessary for complete understanding of this chapter and use of the program. This chapter is intended to be used as a stand-alone manual for use by an estimator performing computer assisted estimates.

5.2 An Introduction to Lotus 1-2-3 Spreadsheet

"Electronic spreadsheets are one of the most ingenious software developments: they combine a straightforward, output oriented user interface with the computer's ability to calculate and display numbers." (7: 69) A spreadsheet is a large group of inter-related cells that are arranged in rows and columns. A cell can contain a number, a mathematical formula, text, or be blank. Values in cells can be linked to other cells by formulas.

Lotus 1-2-3 offers three special features in addition to its basic spreadsheet capabilities. A limited database

capability exists that can manage information based on commands issued by the user. Word processing can be accomplished by a cumbersome yet effective series of menu commands. Graphics can be used to display an easy-to-understand picture of the complex relationship between rows and columns of numbers. Lotus 1-2-3 commands are executed by keystrokes which call up menus and select commands to perform.

A Lotus 1-2-3 macro, in its simplest form, is a collection of keystrokes stored on the spreadsheet. Each keystroke represents a menu command. Macros save time by rapidly executing these keystrokes in the proper sequence. Their real power is when they are used in conjunction with special macro commands. "Version 2.01 incorporates 42 macro commands and 89 functions ranging from the simple absolute value to the complex sum-of-the-years depreciation. In fact, many of the non-graphics functions of BASICA programming language are supported in some way by either 1-2-3 macro commands or functions, making it possible to write comprehensive programs. (7: 69)

5.3 Spreadsheet Organization

Spreadsheet organization is the designation of work areas within the spreadsheet to perform certain functions. The spreadsheet is organized to meet the following criteria:

a. Ease of Use. The areas of the spreadsheet to be used most frequently are grouped close together so that the

user does not have to move around the spreadsheet excessively.

b. Minimize Memory Requirements. The program should use the minimum possible RAM. Lotus 1-2-3 defines its active area (area requiring memory) as a rectangle whose upper left corner begins at "A1", and whose lower right corner is the intersection of the lowest row containing an entry or a formatted cell. Lotus 1-2-3 Release 2 or later is not supposed to use memory for empty cells within this active area but tests indicate use of the Move, Insert, Delete, or File Combine commands can cause empty cells to use up memory. (3: 12-13)

Table 2 shows the organization of the computer assisted estimate. A description of each work area follows. Each work area begins in row one and extends down indefinitely.

TABLE 2

SPREADSHEET ORGANIZATION

A	B	C	D	E	F	G

a. Bid Alternate Breakdown. (Columns A-R) The estimator uses this section to identify the items that compose the various alternates. Up to 15 different bid alternates can be specified in this work area.

b. Detailed Estimate. (Columns Q-AT) This is where the estimator performs the detailed estimate.

c. Database. (Columns BA-CF) This section contains the database of material characteristics and historical information. There is also permanent storage of formulas used in the detailed estimate and a work area to combine information recalled from the data base and these formulas prior to sending them to the detailed estimate.

d. Macro Library. (Columns CJ-CL) This section is used to store the macros commands and data used in macro logic functions.

e. Welcome and Data Input Screen. (Columns CO-CX) This section contains the initial welcome screen and data input area.

f. Summary Sheet. (Columns DF-DY) This section is generated by macro. It is a summary of information on all items that compose an alternate. The summary sheet also includes the final cost breakdown with all costs identified. There is one summary sheet for each alternate.

g. Material Breakdown Sheet. (Columns EE-EL) This sheet lists every material item for a given alternate which has a weight identified in the detailed estimate. When a material item is used more than once, the weights are added together. There is one material breakdown sheet for each alternate.

5.4 Commands

This section discusses the macro commands and procedures which the estimator normally uses in performing a computer assisted estimate. The macro commands are

listed in the order in which they are likely to occur when performing an estimate. Special keys will be shown in this report enclosed with curly brackets. (ie., {ESC} for the escape key) To execute macros, press the alternate key and a letter at the same time. This will be shown with square brackets. (ie., [ALT A] for macro command "A")

The program begins with the introduction screen. Because of the large size of the worksheet and the time it takes to load, there are a series of programed computer generated beeps to alert the estimator when the program is fully loaded and ready to use. The first thing you will see is the introduction screen which welcomes you to the program and advises you that key input data is available for review and modification. This data includes the various labor and overhead rates used by the program, the number and titles of the bid alternates, and the type of format that the program will generate.

Any change in the input data will be reflected throughout the worksheet with two exceptions. (The calculation key, {F9}, must be pressed when in manual recalculation mode to recalculate the entire work sheet. Manual recalculation is the default setting.) The material cost unit prices already on the detailed estimate sheet appear as zero if the estimate format is changed from worksheet format to complete format. Material unit costs will appear as values when recalled from the data base using the complete estimate format. Changes to the

number of alternates or their titles made on the input data work area are not reflected until new summary and material breakdown sheets are generated by the macro routine "FINAL". After reviewing and modifying the input data, the estimator is ready to proceed with the estimate. The following commands are used to complete the estimate:

a. {HOME}. This puts the estimator at the beginning of the detailed estimate.

b. [ALT W]. This command opens or closes a window at the bottom of the screen. The window is used to view text retrieved from the data base on material items. The text contains supplementary information on the material item that is being estimated. The window also displays prompts when executing commands requiring user interface.

c. [ALT A]. This command copies the user entered material description to a work area located above the database. There, information concerning the material item is extracted from the data base and formulas are added. This information is then returned to the detailed estimate for the estimator's use. If an item is not found in the data base, a special subroutine is called which alerts the estimator to this fact. This command should be executed when the cursor is in the description column, column two.

d. [ALT Z] This command sets up the data base for addition, deletion, or modification of a record. When adding or deleting a data base record, the estimator should always check that the data base input data range is correct by following the prompts provided by this command. The

menu command sequence to check the input data range is "/DQI".

e. {F5} CURLINE {RETURN}. This command returns the cursor to the line where the [ALT A] command was last executed. Normally, this is the area where the estimator is currently working.

f. [ALT T]. This command causes the the computer to pause and wait for the estimator to direct it where to find the next macro command. The command permits direct access to any macro line and is useful when calling special routines and debugging.

g. [ALT T] REPEAT {RETURN}. This command will cause the [ALT A] command to be executed a user specified number of times. This can be time saving when information from a large number of items must be recalled from the data base. The repeat command will automatically cease executing if it encounters a blank line as it moves down the column that the command was executed in. Like the [ALT A] command, the cursor should be in the description column, column two, when this command is executed.

h. [ALT D]. This command causes all lines within the detailed estimate below the line containing the cursor to be moved down one line. This command should be executed from the description column, column two, of the detailed estimate. This is useful when inserting an item or narrative. If this command is used on an item after it has been totalled, the item will have to be totalled again.

This can be done by placing the cursor one cell below the last line entry of the item and executing the command to total, [ALT S]. The new totals will write over the old totals.

i. [ALT S]. This command totals key values of an item. All formulas are made absolute so they can later be sent to the material breakdown sheet and the summary sheet. At the conclusion of the command, the cursor is located in column one. This command should be executed with the cursor in the description column, column two.

k. [ALT T] VIEW {RETURN}. This command displays the first fifteen columns. These columns are used to identify the items which compose each alternate. Each column represents an alternate. The items that compose an alternate are selected by scrolling down that alternate's column and placing any number greater than zero in the row that contains the item number and description of an item to be included in that alternate. The program will accommodate more than fifteen alternates by making a copy of the estimate worksheet and using the copy to generate alternates sixteen through thirty. This procedure can be repeated indefinitely. After the alternates and their items are identified, the introduction screen should be reviewed make certain information is still current.

l. {F5} INTRO {RETURN}. This will move the cursor to the welcome and input data screen so that the input data can be reviewed and modified.

m. [ALT T] FINAL {RETURN}. This command generates individual summary sheets and material breakdown sheets for each alternate. It is important to check available RAM by using the "/WS" menu command sequence. This command will stop execution if the available RAM is exceeded by generating the summary and material breakdown sheets. This command presents the option to erase the data base to make room in RAM for these sheets. It is a good idea to make a copy of the estimate before executing this command so there is a back up if further modifications are required. This command can take several hours to execute depending on the number of items, alternates, and their size.

5.5 Cautions

The organization of the spreadsheet precludes the use of the insert, delete, and page commands. The delete command can result in the loss of a data base record, a line from a macro command, and a line of input data from the input data screen. The insert command may result in a modification to the data base that will cause an error in the [ALT A] macro. This command will also cause errors in numerous formulas that are generated by macro. The page command inserts a blank line in the worksheet and is used to signal the printer to begin a new page before continuing to print. It will cause the same damage to the estimate as the insert command.

Estimates in progress are stored temporarily in RAM. An estimator should get in the practice of saving the

estimate to a disk every five or ten minutes to minimize any loss which might occur due to a temporary loss of power and the resulting RAM loss.

Certain macros commands require that the cursor be located in a particular column to perform their function properly. This should be adhered to strictly as a macro will execute its routine regardless of wether or not the cursor was in the correct location. This could mean the loss of data in the detailed estimate, data base, or macro commands.

5.6 Performing a Computer Assisted Estimate

The first step in performing a computer assisted estimate is to recall the program template, TEMPLATE.WK1, from file. This file includes the most recent revisions to the data base and other program components. Once the template is retrieved, the estimator should rename the file to reflect the particular job being estimated. This is done by the "/FS -ENTER NEW NAME- {ESC}" command sequence. This will cause the computer to save the spreadsheet under the new name the next time it is saved.

After the file has been renamed, the estimator should review the input data screens to ensure valid data has been entered. Following this step, the estimator should press {HOME}. This will place the estimator at the top of the detailed estimate work area. This area has labeled columns and extends down to the end of the estimate. Begin the estimate by scrolling down the column to below the heading

line. Number and title the first item.

Enter the first material description below the item title and use the [ALT A] command to recall that item's information from the data base. The [ALT T] REPEAT {RETURN} command sequence can be used to repeat the [ALT A] command automatically when several item descriptions need processed. Complete the estimate by entering the quantity, dimension and labor hours when appropriate. Text can be entered in the description column to clarify or document the estimate. When performing the detailed estimate, always execute macros from the description column, column two. Total an item by using the [ALT S] command. This sequence is repeated for each item.

The summary sheets and material breakdown sheets are macro generated based on information that the estimator inputs. The first step in this process is to identify the alternates and their component items. This is done by executing the [ALT T] VIEW {RETURN} command sequence. This will cause the bid alternate breakdown work area to be exposed and the cursor placed at cell "A1". Columns "A" through "J" each represent an alternate and, if used, will generate their own separate summary and material breakdown sheets. Items are identified as part of the bid alternate by placing numbers other than zero in that alternates column and in the rows containing the component item numbers and titles. Following this step, the data input screens must be updated. Press {F5} INTRO {RETURN} and

scroll down to input the number of alternates, their titles, and the number of items for each alternate.

Because of the size of these sheets and the resulting drain on RAM, it is a good idea to save the completed detailed estimate to file before continuing. Following this, execute the [ALT T] FINAL {RETURN} command sequence. This will cause the computer to ask if you saved a copy of the detailed estimate. If you did not, answer "N" for no and do it now. If you had, answer "Y" for yes and the computer will ask if you want to erase the data base. If your detailed estimate is large or if you have a large number of alternates, it is a good idea to erase the data base to make sure there is room for the summary and material breakdown sheets. Answer "Y" or "N" to this question and the macro will begin generating the summary and material breakdown sheets. This macro will probably take several hours to complete.

Printing the detailed estimate, summary sheets, and material breakdown sheets must be done with Lotus 1-2-3 menu commands. This function could not be standardized with macro commands because of the variable length of the estimate components.

CHAPTER SIX

CASE STUDY

6.1 Purpose

This chapter will demonstrate the value of the computer assisted estimate formats by reviewing a sample estimate based on the the estimates provided in Appendices A and B, and the data presented in Appendix C.

6.2 The Computer Assisted Estimate

The computer assisted estimate program can produce estimates in three formats which were discussed in previous chapters. The complete and worksheet estimate formats as shown in Appendices A and B will be reviewed in this section. The application of the spreadsheet estimate format will then be discussed.

6.2.1 The Complete Estimate

The complete estimate format is composed of a detailed estimate, summary sheets for each alternate, and material breakdown sheets for each alternate. Refer to Appendix A for a sample complete estimate. The review will proceed from single line entries to larger estimate components to better understand the estimate system as an integrated whole.

Each line on the detailed estimate contains twelve columns of information. The use of each column is described below:

a. Column One. This column is used to provide reference for the information listed to its right. This reference may be a number identifying the item, page number from a drawing, or a descriptive note.

b. Column Two. This column is used to describe the material, the item title, or contain any narrative that may document the estimator's assumptions or otherwise clarify the estimate.

c. Columns Three and Four. These columns identify the quantity and dimension of the material required.

d. Column Five. This column is the total weight of the material based upon the quantity, dimension, and a unit weight taken from the data base. Weight is used as one method of estimating labor hours. The material breakdown sheet lists the material items and total weight required for each alternate.

e. Columns Six through Nine. These columns are used to estimate labor hours, by category, that are required to perform the work.

f. Column Ten. This column provides the square feet of surface area based on the quantity and dimension. This information is used when determining labor and material cost for surface treatments.

g. Column Eleven. This column gives the unit cost of the material being estimated.

h. Column Twelve. This column lists the total material cost which is normally the total weight times the

unit cost in $/lb.

The detailed estimate is broken into smaller elements called items. These items are related in some logical manner to provide organization and facilitate the use of the detailed estimate. At the bottom of each item are the item totals. The first row of totals contain the total hours for each labor category and the total weight of steel. This row also contains the schedule which can be used to designate which wage rate to apply to the shop and erection hours. The schedule is also used to plan work loads. The second row of totals is the price breakdown. The cost data from the data input screens are applied to the labor hours and material values. Total overhead is the sum of the labor and material for the item. Labor cost is for direct cost only. The third row of totals gives the net price which includes both direct and indirect costs.

Each alternate has its own summary sheet. The summary sheet consists of key totals taken from the detailed estimate. The summary sheet totals the individual item information. Hauling, profit, taxes, and other costs can be added to account for all costs that occur. Totals, including overhead, are given in the far right column. The total overhead is also provided This is intended as an aide in understanding and controlling overhead costs.

The material breakdown sheet is a summary of all material required for a particular alternate. The material breakdown is based on weight of the material. A material item that has no weight will not show up on the material

breakdown. Material quantities are given in weight.

6.2.2 The Worksheet Estimate

The worksheet estimate (Appendix B) uses the same basic format as the complete estimate format. The estimate includes a complete material take off and labor estimate. Other values are given as blank lines so that the estimate user can input his own data, perform the required calculations,and complete the estimate. The worksheet estimate contains blank lines where the labor hour totals should appear. This was done so that the estimate user can modify individual labor estimates and then total the column himself.

6.2.3 Application of the Spreadsheet Estimate

The spreadsheet estimate is identical to the worksheet estimate except that it is provided on magnetic media. The spreadsheet estimate allows the client to take advantage of the consultant's worksheet format estimate and the speed and accuracy of an electronic spreadsheet. The estimator uses the data input screens (provided as Appendix C) to change the format from worksheet to complete and input his own cost data. Quantities, dimensions, and labor hours can be modified as required. Changes are reflected throughout the entire estimate with the touch of a button.

The data input screen controls how overhead is applied to the direct costs. The methodology is basic enough that a variety of techniques for applying overhead to direct

costs can be accommodated.

CHAPTER SEVEN

CONCLUSION

Computer assisted estimating can be a valuable tool when used to assist estimators. The computer can rapidly store and recall vast quantities of information, exposing the estimator to more and better information. The computer can rapidly perform the many routine calculations that are part of estimating and generate professional reports. The computer can compile the information in an estimate and provide summaries that would otherwise have been impracticable.

With all of these capabilities, it is important to remember that the operative word in computer assisted estimating is assisted. Computer estimating programs must be viewed as a tool to assist the estimator. He must still have the ability to apply his experience, document assumptions, and exercise judgement.

The computer assisted estimating program presented in this report was developed to model the method used by a consultant who provides an estimating service to various clients. The second version of the program has been used since May, 1987. The key benefits the computer assisted estimate has provided are access to a large data base containing accurate and consistent information; rapid performance of routine calculations; well organized,

complete, and neat reports; and more and better analysis of information contained in the estimate, such as the material breakdown and the overhead summary.

The primary application of the computer assisted estimate has been producing worksheet estimates. This will continue as the program is fine tuned and the program user's gain familiarity. The spreadsheet estimate has significant value in that it provides to the clients on magnetic media the worksheet format they are currently using. They can then use the power of the computer to complete their estimate.

Computer assisted estimating shows great promise for the future. It will continue to evolve as the awareness of its potential grows. Hardware and software improvements may enable the computer assisted estimate to expand to become an integrated project management system.

APPENDIX A

THE COMPLETE ESTIMATE

ESTIMATE WORKSHEET

CASE STUDY - COMPLETE FORMAT

NO.	DESCRIPTION	QTY	DIMEN	WEIGHT	SHOP HR	ERECT HR	DRAF HR	MGT HR	SFSA	UNIT COST	MATR COST
1.00	REINFORCING OF EXISTING STEEL ROOF JOISTS - DWG S1										
A-A	PL 3/16	9	50.8 SF	3,509 LB	28.1 S				915 SF	0.26 /LB	$912
	FIG 30.5" x 20'										
	PL 3/16	3	33.1 SF	760 LB	5.7 S				198 SF	0.26 /LB	$198
	FIG 30.5" x 13'										
A-B	PL 3/8	3	26.7 SF	1,225 LB	7.4 S				160 SF	0.27 /LB	$331
	FIG 30.5" x 10.5'										
A-C	PL 3/8	12	13 FT	59 LB	0.4 S				15 SF	0.22 /LB	$13
	RD 3/8	12	15 FT	68 LB	0.5 S				18 SF	0.22 /LB	$15
1.00	TOTALS	01	WGHT STL	5,621 LB	42.0 S	0 E	0 D	0 M	1,307 SF		
	PRICE BREAKDOWN		OH	$449	$504	$0	$0	$0			$1,469
					NET PRICE	$2,422					
2.00	ANGLE SUPPORTS FOR AC UNIT ROOF CURBS - DWG 1										
	L 3 x 3 x 1/4	20	6.5 FT	637 LB	7.6 S				130 SF	0.22 /LB	$140
2.00	TOTALS	01	WGHT STL	637 LB	7.6 S	0 E	0 D	0 M	130 SF		
	PRICE BREAKDOWN		OH	$69	$92	$0	$0	$0			$140
					NET PRICE	$301					

ESTIMATE WORKSHEET

CASE STUDY - COMPLETE FORMAT

NO.	DESCRIPTION	QTY	DIMEN	WEIGHT	SHOP HR	ERECT HR	DRAF HR	MGT HR	SFSA	UNIT COST	MATR COST
3.00	STRUCTURAL FRAMING, COLUMNS AT COLUMN LINE A										
	W 10 x 30	2	25.8 FT	1,548 LB	10.1 S				160 SF	0.28 /LB	$433
	C 10 x 15.3	2	25.8 FT	789 LB	5.1 S				129 SF	0.25 /LB	$197
	WF w/top C, FLs down										
	3 holes web ea end										
COLS	TS 5 x 5 x 1/4	2	26.5 FT	828 LB	7.5 S				88 SF	0.4 /LB	$331
	? also noted as TS4x4x1/4										
	PL 3/8	2	0.48 SF	15 LB	0.6 S				2 SF	0.26 /LB	$4
	conn 3/8x8x8.5 (3 holes)										
	PL 3/4	2	0.56 SF	34 LB	1.4 S				2 SF	0.26 /LB	$9
	BP fig 8x10 (2 holes)										
	PL 1/4	2	0.18 SF	4 LB					1 SF	0.25 /LB	$1
	CP fig 5x5										
	EXP BOLTS fig 3/4 x 6		4 PC		0.1 S					0.12 /PC	$0
	A325 3/4 w/N&W fig		12 PC		0.1 S					0.08 /PC	$1
	fig 2 conn to existing WF col				1.6 S						
3.00	TOTALS	Q1	WGHT STL	3,214 LB	26.4 S	0 E	0 D	0 M	382 SF		
	PRICE BREAKDOWN		OH	$288	$317	$0	$0	$0			$977
					NET PRICE	$1,582					
4.00	ERECTION OF ITEMS 1.00, 2.00, 3.00										
	2 IW 13 DAYS					208 E					
	4 IW 1 DAY					32 E					
	welding, certified, fig rig from existing joists, COL A next to street										
4.00	TOTALS	Q1	WGHT STL	0 LB	0.0 S	240 E	0 D	0 M	0 SF		
	PRICE BREAKDOWN		OH	$1,590	$0	$6,360	$0	$0			$0
					NET PRICE	$7,950					
5.00	WELD EXISTING OH DOOR FIXED IN CLOSED POSITION										
	2 IW 2 HOURS					4 E					
5.00	TOTALS	Q1	WGHT STL	0 LB	0.0 S	4 E	0 D	0 M	0 SF		
	PRICE BREAKDOWN		OH	$27	$0	$106	$0	$0			$0
					NET PRICE	$133					

ESTIMATE WORKSHEET

CASE STUDY - COMPLETE FORMAT

NO.	DESCRIPTION	QTY	DIMEN	WEIGHT	SHOP HR	ERECT HR	DRAF HR	MGT HR	SFSA	UNIT COST	MATR COST
6.00	PIPE BOLLARDS - 2 REQ'D										
	PIPE 4 STD	2	7 FT	151 LB	1.4 S				16 SF	3.27 /FT	$494
	concrete fill not included										
6.00	TOTALS	Q1	WGHT STL	151 LB	1.4 S	0 E	0 D	0 M	16 SF		
	PRICE BREAKDOWN		OH	$59	$16	$0	$0	$0			$494
					NET PRICE	$569					
7.00	ANGLE FRAME AT NEW CONC SLAB FOR HYDROLIC DOOR LIFT										
	L 3 x 3 x 1/4	1	36 LF	176 LB	4.4 S				36 SF	0.22 /LB	$39
	fig studs 3/8 x 4"		430							0.04 /EA	$17
7.00	TOTALS	Q2	WGHT STL	176 LB	4.4 S	0 E	0 D	0 M	36 SF		
	PRICE BREAKDOWN		OH	$37	$55	$0	$0	$0			$56
					NET PRICE	$148					
8.00	ANGLE FRAME AT ROOF HATCH										
	L 3 1/2 x 3 1/2 x 1/4		12 LF	70 LB	1.4 S				14 SF	0.24 /LB	$17
	L 4 x 3 1/2 x 1/4		14 LF	87 LB	1.7 S				18 SF	0.3 /LB	$26
	2 IW 2 HOURS					4 E					
8.00	TOTALS	Q2	WGHT STL	156 LB	3.1 S	4 E	0 D	0 M	32 SF		
	PRICE BREAKDOWN		OH	$41	$39	$52	$0	$0			$43
					NET PRICE	$175					

ESTIMATE WORKSHEET

CASE STUDY - COMPLETE FORMAT

NO.	DESCRIPTION	QTY	DIMEN	WEIGHT	SHOP HR	ERECT HR	DRAF HR	MGT HR	SFSA	UNIT COST	MATR COST
9.00	ALUMINUM LADDER w CAGE TO ROOF SCUTTLE										
	AL FLAT 3/8 x 2 1/2	2	28 FT	62 LB					27 SF	0.38 /LB	$23
	AL RD 1	28	1.4 FT	36 LB					10 SF	0.22 /LB	$8
	AL FLAT 3/8 x 2	12	1 FT	11 LB					5 SF	0.37 /LB	$4
	AL FLAT 1/4 x 2	6	6 FT	21 LB					14 SF	0.28 /LB	$6
	AL FLAT 1/4 x 1 1/2	5	8 FT	18 LB					12 SF	0.27 /LB	$5
	FLAT 3/8 x 2	2	1 FT	5 LB					1 SF	0.22 /LB	$1
	fig AL RH MB 1/2 W/EXP SHLD	12		PC							
	SHOP - LADDER 28 LF @ .600				16.8 S						
	SHOP CAGE 20 LF @ 1.75!				35.0 S						
	ERECTION 2 IW 6 HRS					12 E					
9.00	TOTALS	Q2	WGHT STL	5 LB	51.8 S	12 E	0 D	0 M	68 SF		
	PRICE BREAKDOWN		OH	$432	$648	$156	$0	$0			$47
					NET PRICE	$1,283					
10.00	STEEL CHANNEL DOOR FRAME, HEADER FOR DOOR 22										
	C 12 x 20.7		21 LF	435 LB	6.5 S				62 SF	0.28 /LB	$122
	W 8 x 10	1	7 FT	70 LB	0.6 S				16 SF	0.28 /LB	$20
	FLAT 3/4 x 1		20 LF	51 LB	1.5 S				6 SF	0.32 /LB	$16
	FLAT 3/16 x 2	10	1.33 FT	17 LB	0.7 S				0	0.28 /LB	$5
	L 3 x 3 x 1/4		3 LF	15 LB	0.5 S				3 SF	0.22 /LB	$3
	fig 4 - 1/2 EXP BLTS				0.1 S						
	PAINT - 1 COAT RED OXIDE				0.5 S						$2
10.00	TOTALS	Q2	WGHT STL	587 LB	10.4 S	0 E	0 D	0 M	86 SF		
	PRICE BREAKDOWN		OH	$94	$130	$0	$0	$0			$168
					NET PRICE	$392					

ESTIMATE WORKSHEET

CASE STUDY - COMPLETE FORMAT

NO.	DESCRIPTION	QTY	DIMEN	WEIGHT	SHOP HR	ERECT HR	DRAF HR	MGT HR	SFSA	UNIT COST	MATE COST
11.00	STEEL STAIR - 1st TO 2nd FLOOR										
PLAT	C 6 x 13	4	3 FT	156 LB	4.7 S				20 SF	0.25 /LB	$39
	L 3 1/2 x 3 1/2 x 3/8	4	2 FT	68 LB	1.7 S				9 SF	0.24 /LB	$16
	PL 3/8	8	0.222 SF	27 LB	1.1 S				4 SF	0.26 /LB	$7
	BPs & CPs fig 4" x 8"										
	PL 3/16	1	9 SF	69 LB	1.6 S				18 SF	0.25 /LB	$17
	deck 3' x 3'										
STG	C 6 x 13	2	14 FT	364 LB	21.8 S				46 SF	0.25 /LB	$91
SHOE	FLAT 1/4 x 2	24	1.5 FT	61 LB	15.4 S				0	0.28 /LB	$17
	NO RISER PANS										
	STRINGER END CONNECTION-4				4.0 S						
HR	1 - LINE - 6 LF				6.0 S						
	BOT RETURN				6.0 S						
	INTR PLAT RETURN				4.0 S						
	5 - LINE - 6 LF				9.0 S						
	5 - LINE WALL TERM				3.0 S						
WF	14 LF				2.5 S						
	PIPE 1 1/4 STD		36 LF	89 LB	0.9 S				17 SF	0.6 /FT	$53
	PL 3 3 "	4	6 FT	25 LB	0.5 S				4 SF	0.22 /LB	$5
	FLAT 3/8 x 1 1/2	1	3 FT	6 LB	0.3 S				0	0.28 /LB	$2
	WF BRACKETS	4	PC	0 LB						0.85 /LB	$3
	FASTENERS		100 PC		0.3 S					0.02 /PC	$2
	OTHER MATERIAL 5% x 865 LB			43 LB						0.25 /LB	$11
	ERECTION 2 IW 2 DAYS					32 E					
11.00	TOTALS	82	WGHT STL	908 LB	82.8 S	32 E	0 D	0 M	118 SF		
	PRICE BREAKDOWN		OH	$751	$1,034	$416	$0	$0			$264
					NET PRICE	$2,466					
12.00	DRAFTING, MANAGEMENT FOR ITEMS 10 & 11										
	1 DRAFTSMEN 3 DAYS						14 D				
	MANAGE SITE VISIT, FIELD MEASUREMENTS							3 M			
12.00	TOTALS	02	WGHT STL	0 LB	0.0 S	0 E	14 D	3 M	0 SF		
	PRICE BREAKDOWN		OH	$191	$0	$0	$168	$54			$0
					NET PRICE	$413					

SUMMARY SHEET: CASE STUDY: BASE BID ERECTED ITEMS

NO	DESCRIPTION	SHOP SCH	WGHT STL	SHOP	HOURS ERECT	HOURS DRAFT	HOURS MANAGE	OH COST	MAT'L COST	NE PRICE
1.	REINFORCING OF EXISTING STEEL ROOF JOISTS - DWG 6	Q1	5,621	42.0	0	0	0	$449	$556	$1,419
2.00	ANGLE SUPPORTS FOR AC UNIT ROOF OPENG - DWG 1	Q1	607	7.6	0	0	0	$69	$140	$301
3.00	STRUCTURAL FRAMING, COLUMNS AT COLUMN LINE A	Q1	3,214	26.4	0	0	0	$288	$977	$1,582
4.00	ERECTION OF ITEMS 1.00, 2.00, 3.00	Q1	0	0.0	240	0	0	$1,590	$0	$7,950
5.00	WELD EXISTING DR DOOR FIXED IN CLOSED POSITION	Q1	0	0.0	4	0	0	$27	$0	$133
6.00	ANGLE FRAME AT ROOF HATCH	Q2	156	3.1	4	0	0	$41	$42	$175
9.	ALUMINUM LADDER W/CAGE TO ROOF BOOTTLE	Q1	5	51.8	12	0	0	$432	$47	$1,283
10.	STEEL CHANNEL JOIST FRAME, HEADER FOR DOOR 11	Q2	587	10.4	0	0	0	$94	$168	$392
11.	STEEL STAIR - 1ST TO 2nd FLOOR	Q1	908	61.6	32	0	0	$751	$264	$2,466
12.0	DRAFTING, MANAGE FOR 10 & 11	Q1	0	0.0	0	14	3	$191	$0	$413
	TOTALS		11,129	224.1	292	14	3	$3,932	$2,195	$16,111
					SCHED Q1		25	$240	HAULING	$585
							8.0%	$1,336	PROFIT	$1,336
							NOT APPLICABLE		STATE TAX	$0
							CONTINGENCY	$200	OTHER	$200
								$5,708	TOTAL	$18,232

MATERIAL BREAKDOWN FOR: CASE STUDY: BASE BID
ERECTED ITEMS

MATERIAL DESCRIPTION	QUANTITY (LB)
PL 3/16	4,339
PL 3/8	1,267
RD 3/8	126
L 3 x 3 x 1/4	652
W 10 x 30	1,548
C 10 x 15.3	789
TS 5 x 5 x 1/4	828
PL 3/4	34
PL 1/4	4
L 3 1/2 x 3 1/2 x 1/4	70
L 4 x 3 1/2 x 1/4	87
AL FLAT 3/8 x 2 1/2	62
AL RD 1	36
AL FLAT 3/8 x 2	11
AL FLAT 1/4 x 2	21
AL FLAT 1/4 x 1 1/2	18
FLAT 3/8 x 2	5
C 12 x 20.7	435
W 8 x 10	70
FLAT 3/4 x 1	51
FLAT 3/16 x 2	17
C 6 x 13	520
L 3 1/2 x 3 1/2 x 3/8	68
FLAT 1/4 x 2	61
PIPE 1 1/4 STD	89
RD 5/8	25
FLAT 3/8 x 1 1/2	6

SUMMARY SHEET: CASE STUDY: BASE BID DELIVERED ITEMS

NO	DESCRIPTION	SHOP SCH	WGHT EA	SHOP	HOURS EREC	DRAFT	MANAGE	OH COST	MATL COST	NET PRICE
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	ANGLE FRAME FOR HYDRAULIC LIFT	02	178	4.4	[illegible]	[illegible]	[illegible]	$97	$56	$148
	TOTALS		327	5.8	0	0	0	$96	$550	$718
					SCHED 01		0	$0	HAULING	$0
							8.0%	$57	PROFIT	$57
							NOT APPLICABLE		STATE TAX	$0
								$0	OTHER	$0
								$153	TOTAL	$775

MATERIAL BREAKDOWN FOR: CASE STUDY: BASE BID
DELIVERED ITEMS

MATERIAL DESCRIPTION	QUANTITY (LB)
PIPE 4 STD	151
L 3 x 3 x 1/4	176

SUMMARY SHEET: CASE STUDY: EXCLUDE ITEM 5

NO	DESCRIPTION	SHOP BY	WGHT STL	SHOP	HOURS ERECT	DRAFT	MANAGE	OH COST	MATL COST	NET PRICE
1.00	REINFORCING OF EXISTING STEEL ROOF JOISTS - DWG 01	Q1	5,621	42.				$449	$556	$1,419
2.00	ANGLE SUPPORTS FOR AC UNIT ROOF CURB - DWG 1	Q1	687	7.6	0	0	0	$83	$140	$301
3.00	STRUCTURAL FRAMING, COLUMNS AT COLUMN LINE A	Q1	3,214	26.4	0	0	0	$238	$977	$1,582
4.00	ERECTION OF ITEMS 1.00, 2.00, 3.00	Q1	0	0.0	240	0	0	$1,561	$0	$7,650
6.00	ANGLE FRAME AT ROOF HATCH	Q2	156	2.1	4	0	0	$41	$42	$175
8.00	ALUMINUM LADDER W/CAGE TO ROOF SCUTTLE	Q2	5	51.8	12	0	0	$402	$47	$1,280
10.00	STEEL CHANNEL DOOR FRAME, HEADER FOR DOOR 21	Q2	567	10.4	0	0	0	$94	$168	$392
11.00	STEEL STAIR - 1st TO 2nd FLOOR	Q2	908	82.8	22	0	0	$751	$264	$1,466
12.	DRAFTING MANAGE ITEMS 10 & 11	Q2	0	0.0	0	14	0	$191	$0	$413
	TOTALS		11,139	224.1	288	14	0	$3,905	$2,195	$15,979
					SCHED 02		34	$340	HAULING	$796
							8.0%	$1,342	PROFIT	$1,342
							NOT APPLICABLE		STATE TAX	$0
								$0	OTHER	$0
								$5,587	TOTAL	$18,116

MATERIAL BREAKDOWN FOR: CASE STUDY:
EXCLUDE ITEM 5

MATERIAL DESCRIPTION	QUANTITY (LB)
PL 3/16	4,339
PL 3/8	1,267
RD 3/8	126
L 3 x 3 x 1/4	652
W 10 x 30	1,548
C 10 x 15.3	789
TS 5 x 5 x 1/4	828
PL 3/4	34
PL 1/4	4
L 3 1/2 x 3 1/2 x 1/4	70
L 4 x 3 1/2 x 1/4	87
AL FLAT 3/8 x 2 1/2	62
AL RD 1	36
AL FLAT 3/8 x 2	11
AL FLAT 1/4 x 2	21
AL FLAT 1/4 x 1 1/2	18
FLAT 3/8 x 2	5
C 12 x 20.7	435
W 6 x 10	70
FLAT 3/4 x 1	51
FLAT 3/16 x 2	17
C 6 x 13	520
L 3 1/2 x 3 1/2 x 3/8	68
FLAT 1/4 x 2	61
PIPE 1 1/4 STD	89
RD 5/8	25
FLAT 3/8 x 1 1/2	6

SUMMARY SHEET: CASE STUDY: EXCLUDE ITEM 5

NO	DESCRIPTION	SHOP SCH	WGHT STL	SHOP	HOURS ERECT	DRAFT	MANAGE	OH COST	MATL COST	NET PRICE
1.00	REINFORCING OF EXISTING STEEL ROOF JOISTS - DWG E1	Q1	5,621	42.0	0	0	0	$449	$556	$1,419
2.00	ANGLE SUPPORTS FOR AC UNIT ROOF CURBS - DWG 1	Q1	697	7.6	0	0	0	$69	$14	$201
3.00	STRUCTURAL FRAMING, COLUMNS AT COLUMN LINE A	Q1	3,214	26.4	0	0	0	$288	$977	$1,582
4.00	ERECTION OF ITEMS 1.00, 2.00, 3.00	Q1	0	0.0	240	0	0	$1,590	$0	$7,950
5.00	WELD EXISTING DOOR FIXED IN CLOSED POSITION	Q1	0	0.0	4	0	0	$27	$0	$135
6.00	ANGLE FRAME AT ROOF HATCH	Q2	156	3.1	4	0	0	$41	$43	$175
7.00	STEEL CHANNEL DOOR FRAME, HEADER FOR DOOR 21	Q2	587	10.4	0	0	0	$94	$168	$392
8.00	STEEL STAIR - 1st TO 2nd FLOOR	Q1	308	82.6	32	0	0	$751	$264	$2,466
9.00	D-RATING, MANAGE ITEMS 1 & 11	Q1	0	0.0	0	14	3	$191	$0	$410
	TOTALS		11,124	172.3	280	14	3	$3,500	$2,148	$14,829
					SCHED 21		26	$250	HAULING	$608
							8.0%	$1,235	PROFIT	$1,235
							NOT APPLICABLE		STATE TAX	$0
								$0	OTHER	$0
								$4,984	TOTAL	$16,671

MATERIAL BREAKDOWN FOR: CASE STUDY:
EXCLUDE ITEM 9

MATERIAL DESCRIPTION	QUANTITY (LB)
PL 3/16	4,339
PL 3/8	1,267
RD 3/8	126
L 3 x 3 x 1/4	652
W 10 x 30	1,548
C 10 x 15.3	789
TS 5 x 5 x 1/4	828
PL 3/4	34
PL 1/4	4
L 3 1/2 x 3 1/2 x 1/4	70
L 4 x 3 1/2 x 1/4	87
C 12 x 20.7	435
W 8 x 10	70
FLAT 3/4 x 1	51
FLAT 3/16 x 2	17
C 6 x 13	520
L 3 1/2 x 3 1/2 x 3/8	68
FLAT 1/4 x 2	61
PIPE 1 1/4 STD	89
RD 5/8	25
FLAT 3/8 x 1 1/2	6

SUMMARY SHEET: CASE STUDY: EXCLUDE ITEMS 10, 11, 12

NO	DESCRIPTION	SHOP SIM	WGHT STL	SHOP	H O U R S ERECT	DRAFT	MANAGE	OH COST	MATL COST	NET PRICE
1.0	REINFORCING OF EXISTING STEEL ROOF JOISTS - SHT Q1	Q1	9,621	42.0	0	0	0	$449	$556	$1,419
2.0	ANGLE SUPPORTS FOR AC UNIT ROOF CURBS - DWG 1	Q1	887	7.8	0	0	0	$69	$140	$381
3.0	STRUCTURAL FRAMING, COLUMNS AT COLUMN LINE A	Q1	3,214	26.4	0	0	0	$288	$977	$1,582
4.0	ERECTION OF ITEMS 1.00, 2.00, 3.00	Q1	0	0.0	240	0	0	$1,530	$0	$7,950
5.0	WELD EXISTING OH DOOR FIXED IN CLOSED POSITION	Q1	0	0.0	4	0	0	$27	$0	$133
6.0	ANGLE FRAME AT ROOF HATCH	Q2	156	3.1	4	0	0	$41	$43	$175
9.0	ALUMINUM LADDER W/CAGE TO ROOF	Q2	5	51.8	12	0	0	$432	$47	$1,283
	TOTALS		9,634	131.0	260	0	0	$2,896	$1,763	$12,841
					SCHED Q1		15	$144	HAULING	$351
							6.0%	$1,055	PROFIT	$1,055
							NOT APPLICABLE		STATE TAX	$0
								$0	OTHER	$0
								$4,095	TOTAL	$14,247

MATERIAL BREAKDOWN FOR: CASE STUDY: EXCLUDE ITEMS 10, 11, 12

MATERIAL DESCRIPTION	QUANTITY (LB)
PL 3/16	4,270
PL 3/8	1,240
RD 3/8	126
L 3 x 3 x 1/4	637
W 10 x 30	1,548
C 10 x 15.3	789
TS 5 x 5 x 1/4	828
PL 3/4	34
PL 1/4	4
L 3 1/2 x 3 1/2 x 1/4	70
L 4 x 3 1/2 x 1/4	87
AL FLAT 3/8 x 2 1/2	62
AL RD 1	36
AL FLAT 3/8 x 2	11
AL FLAT 1/4 x 2	21
AL FLAT 1/4 x 1 1/2	18
FLAT 3/8 x 2	5

APPENDIX B

THE WORKSHEET ESTIMATE

ESTIMATE WORKSHEET

CASE STUDY - WORKSHEET FORMAT

NO.	DESCRIPTION	QTY	DIMEN	WEIGHT	SHOP HR	ERECT HR	DRAF HR	MGT HR	SFSA	UNIT COST	MATR COST
1.0	REINFORCING OF EXISTING STEEL ROOF JOISTS - DWG S1										
A-A	FL 3/16	9	50.8 SF	3,509 LB	28.1 S				915 SF	$_____/LB	$_____
	FIG 3.5" x 2"										
	FL 3/16	3	33.1 SF	760 LB	5.7 S				198 SF	$_____/LB	$_____
	FIG 3.5" x 12"										
B-B	FL 3/8	3	26.7 SF	1,225 LB	7.4 S				160 SF	$_____/LB	$_____
	FIG 3.5" x 12.5"										
C-C	RD 3/8	12	13 FT	59 LB	0.4 S				15 SF	$_____/LB	$_____
	RD 3/8	12	15 FT	68 LB	0.5 S				18 SF	$_____/LB	$_____
1.0	TOTALS	Q1	WGHT STL	5,621 LB	_____ S	_____ E	_____ D	_____ M	1,307 SF		
	PRICE BREAKDOWN		OH$_____	$_____	$_____	$_____	$_____				$_____
				NET PRICE	$_____						
2.0	ANGLE SUPPORTS FOR AC UNIT ROOF CURBS - DWG 1										
	L 3 x 3 x 1/4	20	6.5 FT	637 LB	7.6 S				130 SF	$_____/LB	$_____
2.0	TOTALS	Q1	WGHT STL	637 LB	_____ S	_____ E	_____ D	_____ M	130 SF		
	PRICE BREAKDOWN		OH$_____	$_____	$_____	$_____	$_____				$_____
				NET PRICE	$_____						

ESTIMATE WORKSHEET

CASE STUDY - WORKSHEET FORMAT

NO.	DESCRIPTION	QTY	DIMEN	WEIGHT	SHOP HR	ERECT HR	DRAF HR	MGT HR	SFSA	UNIT COST	MATR COST
3.00	STRUCTURAL FRAMING, COLUMNS AT COLUMN LINE A										
	W 1 [illegible]	2	25.8 FT	1,546 LB	10.1 S				160 SF	$_____/LB	$_____
	[illegible] 15.0	2	25.8 FT	789 LB	5.1 S				129 SF	$_____/LB	$_____
	WF [illegible] top [illegible], FLs down										
	3 holes web ea end										
COLB	TS 5 x 5 x 1/4	2	26.5 FT	828 LB	7.5 S				88 SF	$_____/LB	$_____
	[illegible] also noted as TS4x4x1/4										
	PL 3 8	2	0.48 SF	15 LB	0.6 S				2 SF	$_____/LB	$_____
	[illegible] 3 8x8x8.5 3 holes										
	PL 3 4	2	0.56 SF	34 LB	1.4 S				2 SF	$_____/LB	$_____
	SF fig 8x1[illegible] 2 holes										
	PL 1 4	2	0.18 SF	4 LB					1 SF	$_____/LB	$_____
	CP fig 5x5										
	EXP BOLTS fig 3/4 x 6		4 PC		0.1 S					$_____/PC	$_____
	[illegible] 3 4 [illegible] New fig		12 PC		0.1 S					$_____/PC	$_____
	fig 2 [illegible] to existing WF col				1.6 S						
3.00	TOTALS	Q1	WGHT STL	3,214 LB	_____ S	_____ E	_____ D	_____ M	382 SF		
	PRICE BREAKDOWN		OH$_____	$_____	$_____	$_____	$_____				$_____
				NET PRICE	$_____						
4.00	ERECTION OF ITEMS 1.00, 2.00, 3.00										
	2 IW 13 DAYS					208 E					
	4 IW 1 DAY					32 E					
	welding, certified, fig rig from existing joists, COL A next to street										
4.00	TOTALS	Q1	WGHT STL	0 LB	_____ S	_____ E	_____ D	_____ M	0 SF		
	PRICE BREAKDOWN		OH$_____	$_____	$_____	$_____	$_____				$_____
				NET PRICE	$_____						
5.00	WELD EXISTING OH DOOR FIXED IN CLOSED POSITION										
	2 IW 2 HOURS					4 E					
5.00	TOTALS	Q1	WGHT STL	0 LB	_____ S	_____ E	_____ D	_____ M	0 SF		
	PRICE BREAKDOWN		OH$_____	$_____	$_____	$_____	$_____				$_____
				NET PRICE	$_____						

ESTIMATE WORKSHEET

CASE STUDY - WORKSHEET FORMAT

NO.	DESCRIPTION	QTY	DIMEN	WEIGHT	SHOP HR	ERECT HR	DRAF HR	MGT HR	SFSA	UNIT COST	MATR COST
6.00	PIPE BOLLARDS - 2 REQ'D										
	PIPE 4 STD	2	7 FT	151 LB	1.4 S				16 SF	$_____/FT	$_____
	concrete fill not included										
6.	TOTALS	Q1	WGHT STL	151 LB	S	E	D	M	16 SF		
	PRICE BREAKDOWN		OH$_____	$_____	$_____	$_____	$_____				$_____
				NET PRICE	$_____						
7.00	ANGLE FRAME AT NEW CONC SLAB FOR HYDROLIC DOOR LIFT										
	L 2 x 2 x 1/4	1	36 LF	176 LB	4.4 S				36 SF	$_____/LB	$_____
	fig studs 3/8 x 4"		430							$_____/EA	$_____
7.	TOTALS	Q2	WGHT STL	176 LB	S	E	D	M	36 SF		
	PRICE BREAKDOWN		OH$_____	$_____	$_____	$_____	$_____				$_____
				NET PRICE	$_____						
8.00	ANGLE FRAME AT ROOF HATCH										
	L 3 1/2 x 3 1/2 x 1/4		12 LF	70 LB	1.4 S				14 SF	$_____/LB	$_____
	L 4 x 3 1/2 x 1/4		14 LF	87 LB	1.7 S				18 SF	$_____/LB	$_____
	2 1W 2 HOUR					4 E					
8.	TOTALS	Q3	WGHT STL	156 LB	S	E	D	M	32 SF		
	PRICE BREAKDOWN		OH$_____	$_____	$_____	$_____	$_____				$_____
				NET PRICE	$_____						

ESTIMATE WORKSHEET

CASE STUDY - WORKSHEET FORMAT

NO.	DESCRIPTION	QTY	DIMEN	WEIGHT	SHOP HR	ERECT HR	DRAF HR	MGT HR	SFSA	UNIT COST	MATR COST
3.0	ALUMINUM LADDER & CAGE TO ROOF SCUTTLE										
	AL FLAT 3/8 x 2 1/2	2	28 FT	62 LB					27 SF	$_____/LB	$_____
	AL PIPE 1	28	1.4 FT	36 LB					10 SF	$_____/LB	$_____
	AL FLAT 3/8 x 2	12	1 FT	11 LB					5 SF	$_____/LB	$_____
	AL FLAT 1/4 x 2	6	6 FT	21 LB					14 SF	$_____/LB	$_____
	AL FLAT 1/4 x 1 1/2	5	8 FT	18 LB					12 SF	$_____/LB	$_____
	FLAT 3/8 x 2	2	1 FT	5 LB					1 SF	$_____/LB	$_____
	fig AL HH ME 1.2 W/EXP SHLD	12	PC								
	SHOP - LADDER 28 LF @ .600				16.8 S						
	SHOP CAGE 21 LF @ 1.751				35.0 S						
	ERECTION 2 IW 6 HRS					12 E					
3.01	TOTALS	Q2	WGHT STL	5 LB_____	S_____	E_____	D_____	M	68 SF		
	PRICE BREAKDOWN		OH$_____	$_____	$_____	$_____	$_____				$_____
				NET PRICE	$_____						
3.02	STEEL CHANNEL DOOR FRAME, HEADER FOR DOOR 22										
	C 12 x 20.7		21 LF	435 LB	6.5 S				62 SF	$_____/LB	$_____
	W 8 x 10	1	7 FT	70 LB	0.6 S				16 SF	$_____/LB	$_____
	FLAT 3/4 x 1		20 LF	51 LB	1.5 S				6 SF	$_____/LB	$_____
	FLAT 3/16 x 2	10	1.33 FT	17 LB	0.7 S				0	$_____/LB	$_____
	L 3 x 3 x 1/4		3 LF	15 LB	0.5 S				3 SF	$_____/LB	$_____
	fig 4 - 1/2 EXP BLTS				0.1 S						
	PAINT - 1 COAT RED OXIDE				0.5 S						$_____
3.03	TOTALS	Q2	WGHT STL	587 LB_____	S_____	E_____	D_____	M	86 SF		
	PRICE BREAKDOWN		OH$_____	$_____	$_____	$_____	$_____				$_____
				NET PRICE	$_____						

ESTIMATE WORKSHEET

CASE STUDY - WORKSHEET FORMAT

NO.	DESCRIPTION	QTY	DIMEN	WEIGHT	SHOP HR	ERECT HR	DRAF HR	MGT HR	SFSA	UNIT COST	MATR COST
11.00	STEEL STAIR - 1st TO 2nd FLOOR										
PLAT	C 6 x 13	4	3 FT	156 LB	4.7 S				20 SF	$_____/LB$_____	
	L 3 1/2 x 3 1/2 x 3/8	4	2 FT	68 LB	1.7 S				9 SF	$_____/LB$_____	
	PL 3/8	8	0.222 SF	27 LB	1.1 S				4 SF	$_____/LB$_____	
	BPs & CPs fig 4" x 8"										
	PL 3/16	1	9 SF	69 LB	1.6 S				18 SF	$_____/LB$_____	
	deck 3' x 3'										
ST6	C 6 x 13	2	14 FT	364 LB	21.8 S				46 SF	$_____/LB$_____	
SHOE	FLAT 1/4 x 2	24	1.5 FT	61 LB	15.4 S				0	$_____/LB$_____	
	NO RISER PANS										
	STRINGER END CONNECTION-4				4.0 S						
HR	1 - LINE - 6 LF				6.0 S						
	BOT RETURN				6.0 S						
	INTR PLAT RETURN				4.0 S						
	5 - LINE - 6 LF				9.0 S						
	5 - LINE WALL TERM				3.0 S						
WR	14 LF				2.5 S						
	PIPE 1 1/4 STD		39 LF	89 LB	0.9 S				17 SF	$_____/FT$_____	
	RD 5/8	4	6 FT	25 LB	0.5 S				4 SF	$_____/LB$_____	
	FLAT 3/8 x 1 1/2	1	3 FT	6 LB	0.3 S				0	$_____/LB$_____	
	WR BRACKETS	4	PC	0 LB						$_____/LB$_____	
	FASTENERS		100 PC		0.3 S					$_____/PC$_____	
	OTHER MATERIAL 5% x 865 LB			43 LB						$_____/LB$_____	
	ERECTION 2 IW 2 DAYS					32 E					
11.00	TOTALS	Q2	WGHT STL	908 LB_____	S_____	E_____	D_____	M	118 SF		
	PRICE BREAKDOWN			OH$_____	$_____	$_____	$_____	$_____			$_____
					NET PRICE $_____						
12.00	DRAFTING, MANAGEMENT FOR ITEMS 10 & 11										
	1 DRAFTSMEN 3 DAYS						14 D				
	MANAGE SITE VISIT, FIELD MEASUREMENTS							3 M			
12.00	TOTALS	Q2	WGHT STL	0 LB_____	S_____	E_____	D_____	M	0 SF		
	PRICE BREAKDOWN			OH$_____	$_____	$_____	$_____	$_____			$_____
					NET PRICE $_____						

SUMMARY SHEET: CASE STUDY: BASE BID ERECTED ITEMS

NO	DESCRIPTION	SHOP SCH	WGHT STL	HOURS SHOP	HOURS ERECT	HOURS DRAFT	HOURS MANAGE	OH COST	MATL COST	NET PRICE
1.00	REINFORCING OF EXISTING STEEL ROOF JOISTS - DWG S1	Q1	5,621					$	$	$
2.00	ANGLE SUPPORTS FOR AC UNIT ROOF CURBS - DWG 1	Q1	637					$	$	$
3.00	STRUCTURAL FRAMING, COLUMNS AT COLUMN LINE A	Q1	3,214					$	$	$
4.00	ERECTION OF ITEMS 1.00, 2.00, 3.00	Q1	0					$	$	$
5.00	WELD EXISTING OH DOOR FIXED IN CLOSED POSITION	Q1	0					$	$	$
8.00	ANGLE FRAME AT ROOF HATCH	Q2	156					$	$	$
9.00	ALUMINUM LADDER w/CAGE TO ROOF SCUTTLE	Q2	5					$	$	$
10.00	STEEL CHANNEL DOOR FRAME, HEADER FOR DOOR 22	Q2	587					$	$	$
11.00	STEEL STAIR - 1st TO 2nd FLOOR	Q2	908					$	$	$
12.00	DRAFTING, MANAGE FOR 10 & 11	Q2	0					$	$	$
	TOTALS		11,129	S	E	D	M	$	$	$
					SCHED		HR	$	HAULING	$
							%	$	PROFIT	$
									STATE TAX	$
								$	OTHER	$
								$	TOTAL	$

MATERIAL BREAKDOWN FOR: CASE STUDY: BASE BID
ERECTED ITEMS

MATERIAL DESCRIPTION	QUANTITY (LB)
PL 3/16	4,339
PL 3/8	1,267
RD 3/8	126
L 3 x 3 x 1/4	652
W 10 x 30	1,548
C 10 x 15.3	789
TS 5 x 5 x 1/4	828
PL 3/4	34
PL 1/4	4
L 3 1/2 x 3 1/2 x 1/4	70
L 4 x 3 1/2 x 1/4	87
AL FLAT 3/8 x 2 1/2	62
AL RD 1	36
AL FLAT 3/8 x 2	11
AL FLAT 1/4 x 2	21
AL FLAT 1/4 x 1 1/2	18
FLAT 3/8 x 2	5
C 12 x 20.7	435
W 8 x 10	70
FLAT 3/4 x 1	51
FLAT 3/16 x 2	17
C 6 x 13	520
L 3 1/2 x 3 1/2 x 3/8	68
FLAT 1/4 x 2	61
PIPE 1 1/4 STD	89
RD 5/8	25
FLAT 3/8 x 1 1/2	6

SUMMARY SHEET: CASE STUDY: BASE BID DELIVERED ITEMS

NO	DESCRIPTION	SHOP SCH	WGHT STL	HOURS SHOP	HOURS ERECT	HOURS DRAFT	HOURS MANAGE	OH COST	MATL COST	NET PRICE
[illegible]	PIPE BOLLARDS - 2 REQ'D	Q1	151	_____	_____	_____	_____	$_____	$_____	$_____
[illegible]	ANGLE FRAME FOR HYDROLIC LIFT	Q2	176	_____	_____	_____	_____	$_____	$_____	$_____
	TOTALS		327	_____S	_____E	_____D	_____M	$_____	$_____	$_____
						SCHED___	___HR	$_____	HAULING	$_____
							___%	$_____	PROFIT	$_____
								_____	STATE TAX	$_____
								$_____	OTHER	$_____
								$_____	TOTAL	$_____

MATERIAL BREAKDOWN FOR: CASE STUDY: BASE BID
DELIVERED ITEMS

MATERIAL DESCRIPTION	QUANTITY (LB)
PIPE 4 STD	151
L 3 x 3 x 1/4	176

SUMMARY SHEET: CASE STUDY: EXCLUDE ITEM 5

NO	DESCRIPTION	SHOP SCH	WGHT STL	HOURS SHOP	HOURS ERECT	HOURS DRAFT	HOURS MANAGE	OH COST	MATL COST	NET PRICE
1.00	REINFORCING OF EXISTING STEEL ROOF JOISTS - DWG S1	Q1	5,621					$	$	$
2.00	ANGLE SUPPORTS FOR AC UNIT ROOF CURBS - DWG 1	Q1	637					$	$	$
3.00	STRUCTURAL FRAMING, COLUMNS AT COLUMN LINE A	Q1	3,214					$	$	$
4.00	ERECTION OF ITEMS 1.00, 2.00, 3.00	Q1	0					$	$	$
6.00	ANGLE FRAME AT ROOF HATCH	Q2	156					$	$	$
7.00	ALUMINUM LADDER w CAGE TO ROOF SCUTTLE	Q2	5					$	$	$
8.00	STEEL CHANNEL DOOR FRAME, HEADER FOR DOOR 22	Q2	587					$	$	$
10.00	STEEL STAIR - 1st TO 2nd FLOOR	Q2	908					$	$	$
11.00	DRAFTING, MANAGE ITEMS 10 & 11	Q2	0					$	$	$
	TOTALS		11,129	____S	____E	____D	____M	$	$	$
						SCHED___	___HR	$	HAULING	$
							___%	$	PROFIT	$
									STATE TAX	$
								$	OTHER	$
								$	TOTAL	$

MATERIAL BREAKDOWN FOR: CASE STUDY:
EXCLUDE ITEM 5

MATERIAL DESCRIPTION	QUANTITY (LB)
PL 3/16	4,339
PL 3/8	1,267
RD 3/8	126
L 3 x 3 x 1/4	652
W 10 x 30	1,548
C 10 x 15.3	789
TS 5 x 5 x 1/4	828
PL 3/4	34
PL 1/4	4
L 3 1/2 x 3 1/2 x 1/4	70
L 4 x 3 1/2 x 1/4	87
AL FLAT 3/8 x 2 1/2	62
AL RD 1	36
AL FLAT 3/8 x 2	11
AL FLAT 1/4 x 2	21
AL FLAT 1/4 x 1 1/2	18
FLAT 3/8 x 2	5
[illegible] x 20.7	435
W 8 x 10	70
FLAT 3/4 x 1	51
FLAT 3/16 x 2	17
[illegible] 8 x 13	520
L 3 1/2 x 3 1/2 x 3/8	68
FLAT 1/4 x 2	61
PIPE 1 1/4 STD	89
PL 5/8	25
FLAT 3/8 x 1 1/2	6

SUMMARY SHEET: CASE STUDY: EXCLUDE ITEM 9

NO	DESCRIPTION	SHOP SCH	WGHT STL	HOURS SHOP	HOURS ERECT	HOURS DRAFT	HOURS MANAGE	OH COST	MATL COST	NET PRICE
1.00	REINFORCING OF EXISTING STEEL ROOF JOISTS - DWG S1	Q1	5,621					$	$	$
2.00	ANGLE SUPPORTS FOR AC UNIT ROOF CURBS - DWG 1	Q1	637					$	$	$
3.00	STRUCTURAL FRAMING, COLUMNS AT COLUMN LINE A	Q1	3,214					$	$	$
4.00	ERECTION OF ITEMS 1.00, 2.00, 3.00	Q1	0					$	$	$
5.00	WELD EXISTING OH DOOR FIXED IN CLOSED POSITION	Q1	0					$	$	$
6.00	ANGLE FRAME AT ROOF HATCH	Q2	156					$	$	$
7.00	STEEL CHANNEL DOOR FRAME, HEADER FOR DOOR 22	Q2	587					$	$	$
11.00	STEEL STAIR - 1st TO 2nd FLOOR	Q2	908					$	$	$
12.00	DRAFTING, MANAGE ITEMS 10 & 11	Q2	0					$	$	$
	TOTALS		11,124	____S	____E	____D	____M	$	$	$
					SCHED___		___HR	$	HAULING	$
							___%	$	PROFIT	$
									STATE TAX	$
								$	OTHER	$
								$	TOTAL	$

MATERIAL BREAKDOWN FOR: CASE STUDY:
EXCLUDE ITEM 9

MATERIAL DESCRIPTION	QUANTITY (LB)
PL 3/16	4,339
PL 3/8	1,267
RD 3/8	126
L 3 x 3 x 1/4	652
W 10 x 30	1,548
C 10 x 15.3	789
TS 5 x 5 x 1/4	828
PL 3/4	34
PL 1/4	4
L 3 1/2 x 3 1/2 x 1/4	70
L 4 x 3 1/2 x 1/4	87
C 12 x 20.7	435
W 8 x 10	70
FLAT 3/4 x 1	51
FLAT 3/16 x 2	17
C 6 x 13	520
L 3 1/2 x 3 1/2 x 3/8	68
FLAT 1/4 x 2	61
PIPE 1 1/4 STD	89
RD 5/8	25
FLAT 3/8 x 1 1/2	6

SUMMARY SHEET: CASE STUDY: EXCLUDE ITEMS 10, 11, 12

NO	DESCRIPTION	SHOP SCH	WGHT STL	HOURS SHOP	HOURS ERECT	HOURS DRAFT	HOURS MANAGE	OH COST	MATL COST	NET PRICE
1.00	REINFORCEING OF EXISTING STEEL ROOF JOISTS - DWG S1	Q1	5,621	_____	_____	_____	_____	$_____	$_____	$_____
2.00	ANGLE SUPPORTS FOR AC UNIT ROOF CURBS - DWG 1	Q1	637	_____	_____	_____	_____	$_____	$_____	$_____
3.00	STRUCTURAL FRAMING, COLUMNS AT COLUMN LINE A	Q1	3,214	_____	_____	_____	_____	$_____	$_____	$_____
4.00	ERECTION OF ITEMS 1.00, 2.00, 3.00	Q1	0	_____	_____	_____	_____	$_____	$_____	$_____
5.00	WELD EXISTING OH DOOR FIXED IN CLOSED POSITION	Q1	0	_____	_____	_____	_____	$_____	$_____	$_____
6.00	ANGLE FRAME AT ROOF HATCH	Q2	156	_____	_____	_____	_____	$_____	$_____	$_____
9.00	ALUMINUM LADDER w/CAGE TO ROOF	Q2	5	_____	_____	_____	_____	$_____	$_____	$_____
	TOTALS		9,634	_____S	_____E	_____D	_____M	$_____	$_____	$_____
						SCHED___	___HR	$_____	HAULING	$_____
							___%	$_____	PROFIT	$_____
								_____	STATE TAX	$_____
								$_____	OTHER	$_____
								$_____	TOTAL	$_____

MATERIAL BREAKDOWN FOR: CASE STUDY: EXCLUDE ITEMS 10, 11, 12

MATERIAL DESCRIPTION	QUANTITY (LB)
PL 3/16	4,270
PL 3/8	1,240
RD 3/8	126
L 3 x 3 x 1/4	637
W 10 x 30	1,548
C 10 x 15.3	789
TS 5 x 5 x 1/4	828
PL 3/4	34
PL 1/4	4
L 3 1/2 x 3 1/2 x 1/4	70
L 4 x 3 1/2 x 1/4	87
AL FLAT 3/8 x 2 1/2	62
AL RD 1	36
AL FLAT 3/8 x 2	11
AL FLAT 1/4 x 2	21
AL FLAT 1/4 x 1 1/2	18
FLAT 3/8 x 2	5

APPENDIX C

WELCOME AND DATA INPUT SCREENS

```
**************************************************************************
*                                                                        *
*                                                                        *
*            WELCOME TO ESTIMATOR BY CHRIS REILING                       *
*                                                                        *
*                                                                        *
**************************************************************************
```

THIS SECTION OF THE SPREADSHEET IS USED TO INPUT COST DATA AND OTHER KEY INPUT VARIABLES. SCROLL DOWN TO REVIEW OR CHANGE THE CURRENT INPUT DATA. TO RETURN TO THIS DISPLAY PRESS [F5], TYPE "INTRO", AND HIT [RETURN]. MOVE TO THE DETAILED ESTIMATE WORKSHEET BY PRESSING [HOME].

A DETAILED EXPLAINATION OF THIS PROGRAM IS GIVEN IN THE USER'S MANUAL. THIS PROGRAM SHOULD NOT BE USED WITHOUT A BASIC UNDERSTANDING OF LOTUS 1-2-3 AND THE USER'S MANUAL.

SCHEDULE (BY QUARTERS)	*SHOP LABOR RATES*							
Q1	DC=	$12.00	OH @	60.0%=	$7.20	TOTAL =	$19.20
Q2	DC=	$12.50	OH @	60.0%=	$7.50	TOTAL =	$20.00
Q3	DC=	$12.50	OH @	60.0%=	$7.50	TOTAL =	$20.00
Q4	DC=	$12.50	OH @	60.0%=	$7.50	TOTAL =	$20.00
Y2	DC=	$13.00	OH @	60.0%=	$7.80	TOTAL =	$20.80
	ERECTION LABOR RATES						
Q1	DC=	$26.50	OH @	25.0%=	$6.63	TOTAL =	$33.13
Q2	DC=	$13.00	OH @	25.0%=	$3.25	TOTAL =	$16.25
Q3	DC=	$17.00	OH @	25.0%=	$4.25	TOTAL =	$21.25
Q4	DC=	$20.00	OH @	25.0%=	$5.00	TOTAL =	$25.00
Y2	DC=	$15.00	OH @	30.0%=	$4.50	TOTAL =	$19.50
	HAULING RATES						
Q1	DC=	$12.00	OH @	80.0%=	$9.60	TOTAL =	$21.60
Q2	DC=	$12.50	OH @	80.0%=	$10.00	TOTAL =	$22.50
Q3	DC=	$12.50	OH @	80.0%=	$10.00	TOTAL =	$22.50
Q4	DC=	$12.50	OH @	80.0%=	$10.00	TOTAL =	$22.50
Y2	DC=	$13.00	OH @	80.0%=	$10.40	TOTAL =	$23.40
DRAFTING	DC=	$12.00	OH @	85.0%=	$10.20	TOTAL =	$22.20
MANAGEMENT	DC=	$18.00	OH @	90.0%=	$16.20	TOTAL =	$34.20

MISCELLANEOUS INPUT DATA

DEFAULT MATERIAL OVERHEAD RATE (INPUT AS A DECIMAL)= 10.0%

NOTE: SPECIAL ITEMS SUCH AS EQUIPMENT RENTAL AND SUB-CONTRACT ITEMS ARE TREATED AS MATERIAL COSTS AND THUS HAVE THE MATERIAL DEFAULT OVERHEAD RATE.

NUMBER OF BID ALTERNATES FOR THIS JOB (1-15)= 1

ENTER THE NUMBER OF ITEMS AND TITLE FOR EACH BID ALTERNATE:

	#	TITLE
BID ALTERNATE 1	===>	3 BASE BID - SAMPLE ESTIMATE
BID ALTERNATE 2	===>	
BID ALTERNATE 3	===>	
BID ALTERNATE 4	===>	
BID ALTERNATE 5	===>	
BID ALTERNATE 6	===>	
BID ALTERNATE 7	===>	
BID ALTERNATE 8	===>	
BID ALTERNATE 9	===>	
BID ALTERNATE 10	===>	
BID ALTERNATE 11	===>	
BID ALTERNATE 12	===>	
BID ALTERNATE 13	===>	
BID ALTERNATE 14	===>	
BID ALTERNATE 15	===>	

ESTIMATE FORMAT

ENTER "WKS" TO CREATE A WORK SHEET ESTIMATE OR ENTER "COMPLETE" TO CREATE A COMPLETE ESTIMATE OR TO CHANGE A WORKSHEET ESTIMATE FORMAT TO A COMPLETE ESTIMATE FORMAT.

ENTER "WKS" OR "COMPLETE" ===> COMPLETE

NOTE: PLEASE CONSULT THE USER'S MANUAL FOR INSTRUCTIONS ON HOW TO INPUT DATA AND HOW IT IS USED IN THE PROGRAM. THE MANUAL ALSO CONTAINS A COMPLETE EXPLAINATION OF KEY MACRO COMMANDS USED BY THIS PROGRAM.

APPENDIX D

MACRO LIBRARY

```
\M      {MACRO}                     <=== CALLS "MACRO" SUBROUTINE

\C      /WCS                        <=== SETS UP TO CHANGE COLUMN WIDTH

MACRO   /RNLR^                      <=== CREATES A MACRO

\0      {BEEP}/WWC{GOTO}\0^{L}      <=== AUTOEXEC MACRO THAT BEEPS TO
        {BEEP}{END}{D}{MACRO}           LET THE USER KNOW THAT THE FILE
        /WCD{HOME}.{R 15)^              HAS BEEN RETRIEVED AND TAKES THE
        /WCH{HOME}.{R 15)^              USER TO THE INTRODUCTION SCREEN.
        {BEEP}{GOTO}INTRO^
        {BEEP}

\W      {HOME}{D 12)/WWH/WWU        <=== OPENS WINDOW AND LABELS OTHER
        {GOTO}\W^{L}{END}{D}            \W MACRO.
        {MACRO}{WINDOW}{GOTO}
        CHALK^{WINDOW}{GOTO}
        CURLINE^

\W      /WWC{GOTO}\W^{L}{END}       <=== CLOSES WINDOW AND LABELS OTHER
        {U}{MACRO}{GOTO}CURLINE^        \W MACRO.

\T      /X6{?}^                     <=== MACRO USED TO TEST OTHER
                                        MACROS AND SUBROUTINES AT ANY POINT
                                        IN THEIR SEQUENCE.  THIS MACRO ALSO
                                        PERMITS THE USER TO DIRECTLY
                                        EXECUTE SUBROUTINES.
```

```
\A      ^{END}{L}{R}                <=== TAKES INPUTTED ITEM
        /RNDCURLINE^                DESCRIPTION FROM THE WORK AREA AND
        /RNDCURLINE^^               USES IT TO EXTRACT DATA FROM THE
        /REC0121..CO130^            DATA BASE.  FORMULAS ARE ADDED AND
        /C^DESCRIBE^                THE DATA IS SENT TO THE WORK AREA.
        /DBEQ/RUOUTPUTR^
        {IF BF8=0}/XGCK56^
        /CB610..BQ10^B68^
        /CBX10..CA10^BX8^
        /CBT10..BU10^BT8^
        {IF CS84="WKS"}/CBV10^BV8^
        /RUCOPYOUTPUT^
        /CCOPYOUTPUT^^
        /CREMARKS1^CO121^
        /CREMARKS2^CO122^
        /CREMARKS3^CO123^
        /RJCO121..CW130^
        {R 5}/RF,0^^
        {R 3}/RF,1^^{R}/RF,0^
        {R 9}^
        {R 9}/RFGC2^{R}
        /RFC0^{R}^
        {L 22}/RF^^{U}^{R}{CALC}

NF      /CNOTFOUND^CO121^           <=== SUBROUTINE THAT IS CALLED WHEN
        {R}ITEM NOT FOUND{L}        AN ITEM IS NOT FOUND IN THE
        {CALC}{RETURN}              DATABASE.

COUNT1                        4.00 <=== COUNTERS USED IN "FOR" LOOPS
COUNT2                             AND AS LOCATIONS FOR TEMPORARY DATA
COUNT3  ---------------------------STORAGE DURING LOGIC OPERATIONS.
COUNT4  FLAT 3/8 x 2
COUNT5



REPEAT  {GETNUMBER "HOW MANY ITEMS  TO \A? :",COUNT2)^
        {U}
        {FOR COUNT1,0,COUNT2-1,1,REPEAT1}
        {BEEP}{BEEP}{BEEP}
                                    ^
REPEAT1 {D}{\A}                     <=== "REPEAT" AND "REPEAT1"
        {RETURN}                    SUBROUTNES ARE USED TO REPEAT "\A"
                                    MACRO COMMAND A USER SPECIFIED
                                    NUMBER OF TIMES.
```

```
\S      {END}{L}\-~/C~.{R 28}~      \=== TOTALS SELECTED ITEM VALUES AS
        {D}{R}TOTALS{L}             PART OF THE DETAILED ESTIMATE.
        /REC0121..CW130~
        /CTOTALTEXT1~C0122~
        @SUM({U 2}.{END}{U}{?})~
        {EDIT}{HOME}
        @IF($CS$84="WKS",
        "_______",{END})~
        /C~{R 10}.{R 18}~
        {R 3}?@?{R 6}{EDIT}
        {L 2}{ABS}{L 25}__~/RF,1~~{R}S
        {R}{EDIT}{L 2}{ABS}{L 25}__~/RF,0~~{R}E
        {R}{EDIT}{L 2}{ABS}~/RF,0~~{R}D
        {R}{EDIT}{L 2}{ABS}~/RF,0~~{R}M
        {R}/RF,0~~{EDIT}{BS}{L}{ABS}
        {HOME}{DEL 27}~{R}SF{R}
        /RE{R}~{R 2}{EDIT}{HOME}{R 18}
        ${DEL}{END}{L 2}{ABS}~/RFC0~~
        /M~{D 3}~/WCD{R 3}~
        {R}{EDIT}{BS}{L 8}{ABS}
        {HOME}{DEL 27}~/RF,0~~
        /M~{L 20}~/WCH~
        {L 15}LB{L 3}WGHT STL
        {L 4}?#?{D 3}{R}
        PRICE BREAKDOWN{R 4}OH
        {R}@IF($CS$84="WKS",
        "$_____",@VLOOKUP({U 3}
        {L 4}{ABS},$SR,6)*{U 3}{R 3}{ABS}+
        @VLOOKUP({U 3}{L 4}{ABS},$ER,6)*
        {U 3}{R 5}{ABS}+CU45{ABS}*{U 3}
        {R 7}{ABS}+CU47{ABS}*{U 3}{R 9}
        {ABS}+{U 3}{R 19})~/RFC0~~
        {R 3}@IF($CS$84="WKS","$_____",
        {U 3}{ABS}*@VLOOKUP({U 3}
        {L 7}{ABS},$SR,2))~/RFC0~~
        {R 2}@IF($CS$84="WKS","$_____",
        {U 3}{ABS}*@VLOOKUP({U 3}
        {L 9}{ABS},$ER,2))~/RFC0~~
        {R 2}
        @IF($CS$84="WKS","$_____",
        {U 3}{ABS}*$CQ$45)~/RFC0~~{R 2}
        @IF($CS$84="WKS","$_____",
        {U 3}{ABS}*$CQ$47)~/RFC0~~{R 2}
        {D 2}{L 6}
        @IF($CS$84="WKS","$_____",
        @SUM({U 2}{L 5}
        .{R 9}{ABS}))~/RFC0~~
        {L 4}  NET PRICE
        {BIGLEFT}{END}{U}/RFF~~{CALC}
```

```
FINAL    {GETLABEL "DID YOU MAKE A COPY^ (Y/N) ",COUNT1}
         {IF COUNT1<>"Y"}/FS{QUIT}
         {GETLABEL "DO YOU WANT TO ERASE THE DATA BASE^ (Y/N) ",COUNT2}
         {IF COUNT2="Y"}/REBA1..CD8000^
         /RNCMARKSS^DF10^          <=== SUBROUTINE TO PERFORM INITIAL
         /RNCMARKMB^EE10^          SETUP OF THE SUMMARY SHEET AND THE
         /RNCMARKSS^{D 5}^         MATERIAL BREAKDOWN SHEET.  ADDS
         /CSSTEMP^MARKSS^          TITLES TO THE FIRST SUMMARY AND
         {GOTO}MARKSS^{R 6}@VLOOKUP MATERIAL BREAKDOWN SHEETS.
         {1,ALTTITLES,3}^/RV^^     ESTABLISHES THE INITIAL LOCATION OF
         /RNCMARKMB^{D 5}^         THE FLOATING RANGES ON NEW SUMMARY
         /CMBTEMP^MARKMB^          SHEETS AND NEW MATERIAL BREAKDOWN
         {GOTO}MARKMB^{D}{R}@VLOOKUP  SHEETS.
         {1,ALTTITLES,3}^/RV^^
         /WCD{HOME}.{R 15}^
         /RNCFLOATSS^DF1^
         /RNCFLOATMB^EE1^
         /RNCFLOATWKS^A2^
>>F2     {GOTO}MARKSS^{D 5}/RND
         FLOATSS^/RNC
         FLOATSS^^{GOTO}MARKMB^{D 5}
FINAL2   /RNDFLOATMB^/RNC
         FLOATMB^^
         {LET COUNT1,-1}
>>ALT    {LET COUNT1,COUNT1+1}
         {HOME}
         {CALC}
         {D}
FINAL3   {HOME}{R COUNT1}          <=== THIS SUBROUTINE IDENTIFIES
FINAL4   {END}{D}/C^COUNT2^        ITEMS TO BE INCLUDED IN EACH BID
>>F4     {IF @VALUE(COUNT2)=0}/XGCK2  ALTERNATE.  DATA IS CATEGORIZED
         {IF COUNT2="@"}/XGCK164^  AND SENT TO EITHER THE SUMMARY
         '@{R 16-COUNT1}           SHEET OR THE MATERIAL BREAKDOWN
         /C.{R}^FLOATSS^           SHEET.  THE FLOATING RANGES SERVE
         /RNCFLOATSS^{R 2}^        AS A "TARGET" TO AIM THE DATA.
         {R 6}
FINAL6   {D}/RV^COUNT3^
         {IF @VALUE(COUNT3)=0}/XGCK171^
         {IF COUNT3=CV5}/XGCK262^
>>F6     {IF COUNT3>0}/XGCK179^
FINAL5   /RNDFLOATWKS^             <=== SUBROUTINE TO TAKE DATA FROM
         /RNCFLOATWKS^^            THE DETAILED ESTIMATE AND SENDS IT
         {L 5}/C^COUNT4^           TO THE MATERIAL BREAKDOWN SHEET.
         {GOTO}FLOATMB^{U}
FINAL7   {D}/C^COUNT5^
         {IF @VALUE(COUNT5)=0}/CCOUNT4^^/XGCK194^
         {IF COUNT4=COUNT5}/XGCK194^
>>F7     {IF COUNT4<>COUNT5}/XGCK183^
         {HOME}ERROR FINAL7^
         {QUIT}
```

```
ENDALT   {GOTO}FLOATSS~              <=== SUBROUTINE TO TOTAL THE
         {U}                         SUMMARY SHEET FOR A BID ALTERNATE
         \-~/C~.{R 19)~              AND SET UP TO SEARCH FOR THE NEXT
         {D 2}{R}"TOTALS{R 2)        ALTERNATE.
         @SUM({U 3).{U CV6))
         {EDIT}{HOME}
         @IF($CS$84="WKS","_____",
         {END))~/RF,0~~
         /C~.{R 13)~{EDIT)
         {BS}{HOME}{DEL 26}~
         {R}{EDIT}{HOME}{R 25)
         {L}S~/RF,1~~
         {R}{EDIT}{HOME}{R 24}E~
         {R}{EDIT}{HOME}{R 24}D~
         {R}{EDIT}{HOME}{R 24}M~
         {R}{EDIT}{HOME}{R 15}{R 3)
         $_~/RFC0~{R 2}~
         {R}{EDIT}{HOME}{R 15}{R 3}$_~
         {R}{EDIT}{HOME}{R 15}{R 3}$_~
         {D 2}@IF($CS$84="WKS",
         "$_________",@VLOOKUP
         ((L 4),HR,8)*{L 4))~{L)
         HAULING{L)
         @IF($CS$84="WKS","$_____",
         @VLOOKUP((L 4),HR,6)*{L 2))~
         {L 3)"SCHED{R)'___{R)___HR
         {D 2)"___% {R)
         @IF($CS$84="WKS","$_____",
         ({R 2){U 4)+{R 2){U 2))*{L 2))~
         {R)PROFIT{R)+{L 2)~
         {D 2)'$_____{L)
         STATE TAX{L 2)\_{R 2){D 2)
         OTHER{L)'$_____{R 2)+{L 2)~
         {L 3)\_~{R 3){D 2)
         @IF($CS$84="WKS","$_____",
         @SUM({U 2).{U 8)))~
         /C~{L 2)~/RFC0~{U 8){L 2)~
         /RNCMARKSS~~
         /RNCMARKMB~{D 3){END){D)
         /CSSTEMP~MARKSS~
         {GOTO)MARKSS~{R 6)@VLOOKUP
         (COUNT1+2,ALTTITLES,3)~/RV~~
         /CMBTEMP~MARKMB~
         {GOTO)MARKMB~{D){R)@VLOOKUP
         (COUNT1+2,ALTTITLES,3)~/RV~~
         {GOTO)MARKSS~{D 5}/RND
         FLOATSS~/RNC
         FLOATSS~~{GOTO)MARKMB~{D 5}
         /RNDFLOATMB~/RNC
         FLOATMB~~
         {GO}{ESC}~
```

```
ADDMAT   (F)(EDIT)+FLOATWKS~          <=== SUBROUTINE THAT ADDS THE
  FE     (GOTO)FLOATWKS~ XGCK171~     WEIGHT OF SIMILAR MATERIAL TYPES
                                      TOGETHER ON THE MATERIAL BREAKDOWN
                                      SHEET.

TOTAL    (D)(L 3)/C(R 13)~FLOATSS~    <=== SUBROUTINE TO SEND SELECTED
         /RNCFLOATSS~(R 15)~          ITEM TOTALS TO THE SUMMARY SHEET
         (D 3)(R 3)/C~FLOATSS~
         /RNCFLOATSS~(R)~
         (R 15)/C~FLOATSS~
         /RNCFLOATSS~(R)~
         (D 2)(L 10)/C~FLOATSS~
         /RNCFLOATSS~(D 2)(L 19)~
         /XGCK163~

VZ       (GETLABEL "ENTER 'A' TO ADD OR DELETE, OR 'M' TO MODIFY AN ITEM
         (IF COUNT1="A")(ADDITEM)
         (IF COUNT1="M")(MODITEM)     <=== SETS UP TO MODIFY THE DATA BASE
         (QUIT)

ADDITEM  (GETLABEL "DON'T FORGET TO CHANGE THE DATA INPUT RANGE (/DQI) H
         (GOTO)BE13~(QUIT)


MODITEM  (GETLABEL "ENTER THE ITEM TO BE MODIFIED. ",COUNT1)
         (GETLABEL "WHEN DONE, PRESS ESCAPE THEN 'Q'- HIT RETURN TO CONT
         /CCOUNT1~DESCRIBE~
         /DQF

HIDE     (VIEW)/WCH(HOME).(R 15)~     <=== MACRO TO HIDE FIRST 15 COLUMNS

VIEW     /WCD(HOME).(R 15)~            <=== MACRO TO DISPLAY FIRST 15
         (HOME)                       COLUMNS

VD       (END)(L)                      <=== MACRO TO MOVE DETAILED
         (M(R 30)(END)(D)(U)~         ESTIMATE DOWN ONE ROW.
         (D)~
```

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END

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